THE TELEGRAPHIC JOURNAL AND

Electrical Review.

Vol. XIII.—No. 293.

UNDERGROUND WIRES.

That the days of aerial wires in large towns are numbered seems almost certain, and many efforts are continually being made to effect a settlement in the matter, though not entirely with definite results. It is generally admitted, we think, that aerial wires are unsightly, and that they are a source of possible danger can hardly admit of doubt, although up to the present the accidents which have resulted from their existence have been but few. The recent deputation to Sir Charles Dilke, which consisted of representatives from forty of the Metropolitan Vestries, the City Commissioners of Sewers, &c., although it has not caused any satisfactory decision to be obtained on the subject, will no doubt prove instrumental in causing something to be done eventually The whole matter is, however, beset with difficulties, and this the more so in consequence of the comparative apathy which up to the present has existed in dealing with the question.

The general solution to the whole question is of course the replacing of the aerial wires by underground work. If it were merely the Post-office who were concerned in the matter there would be comparatively little difficulty in effecting the requirement, for the question in this case would be merely one of expense, and although this would practically mean a slight increase in the taxes which the British public would have to pay, yet money laid out in this way would not be missed to the same extent that it would if it had to be paid by not over prosperous telephone companies. The Post-office, however, although it has not acted as promptly in the matter as it might have done, had extreme pressure been brought to bear thereon, has at least not been idle, and the large and continual increase in the mileage of the underground work within the metropolitan area is accompanied by a decrease in the mileage of aerial wires, which, although small, is yet continual.

Expense is, of course, not the only difficulty in the way of the substitution of underground for aerial wires; for though expense is a very serious consideration in the case of not over prosperous companies, financially speaking, the possibility of *working* through underground wires requires to be considered. The working capacity of an open wire is very greatly in excess of that of an underground wire as at present arranged; that is to say, a telephone which would work satisfactorily over a long length of aerial wire, would only work satisfactorily through a very much shorter length of underground wire, probably not through a greater length than about 10 or 15 miles. In the majority of cases it is not required, at present, to speak to long distances, and if the business of a telephone exchange were confined to a radius of five or six miles there would probably be little difficulty in carrying on the communication, but when long distances are required to be worked over, the necessity for employing through towns, even moderate lengths of underground wire, in addition to the aerial line erected between the outskirts of the localities in communication, would be a serious obstacle to successful working.

At present the only known cure for inductive retardation (which is the obstacle to long distance underground working) is to increase the thickness of the insulating envelope, so as to diminish the electrostatic capacity of the circuit, but this, although it could be effected comparatively cheaply, for there is no necessity to employ an expensive or highly insulating material for the purpose, would have the great disadvantage of greatly increasing the bulk of each circuit, and consequently of diminishing the number which could be included in the protecting pipe.

Sooner or later the question of underground wires, for large towns at least, will have to be seriously considered, but up to the present no really cheap and satisfactory system has been devised, except in the imagination of many sanguine inventors. The very great majority of the projects for underground lines which have been patented are useless for practical purposes, and show that the inventors have no knowledge of the requirements necessary to insure success. The whole question presents much greater difficulties than might be imagined, and these difficulties can only be thoroughly realised by those who have had experience in work of the kind. But, nevertheless, we think it only requires the declaration of the local authorities to the effect that the aerial wires must be removed to bring about the remedy, though it be one which may entail considerable inconvenience and not a little expense.

ELECTRIC LAMP.

DE PUYDT'S SYSTEM.

M. A. de Puydt, engineer to Jasper & Co., at Liége, has recently invented a new arrangement of electric lamp which recommends itself by the simplicity of its mechanism and the remarkable regularity of its action. This is described in the *Revue Industrielle*, from which we obtain our information.

The arc is regulated in this lamp by a derived current the function of which is to maintain constant the difference of potential at the two carbon-holders.

The subjoined figure will suffice, with the following description, to explain the working :—

The two carbon-holders form racks at their upper part and are in gear with two pinions fixed upon the same arbor. These pinions are arranged for keeping a fixed luminous point, in contrast to the action of most lamps where the arc descends according to the consumption of the lower carbon. Upon this arbor is also fixed the first of a series of gear wheels, A, put in motion by the weight of the upper carbon-holder. The last wheel of this oblique escapement bears projections which are engaged or disengaged at the proper time by a stop, *a*, fixed to the armature of the fine wire electro-magnet, Q, which is traversed by the derived current. Another electro-magnet, P, is actuated by the current of the arc and in attracting its armature, P^1, makes the whole clockwork movement oscillate around the lower arbor, upon which are fixed the pinions working the racks. There are then in this apparatus two distinct actions: First, the attraction of the thick wire electro-magnet, P, which produces at the outset the separation of the carbons by making the clockwork movement describe a certain angle, as is explained above, which communicates motion to the two pinions which govern the carbon-holders; second, the attraction of the fine wire electro-magnet, Q, which keeps this distance fixed by disengaging the gear wheels directly the difference of potential has exceeded the proper limit. An important detail to be observed is that the armature, Q, as well as the stop are supported by the arbor of the origin

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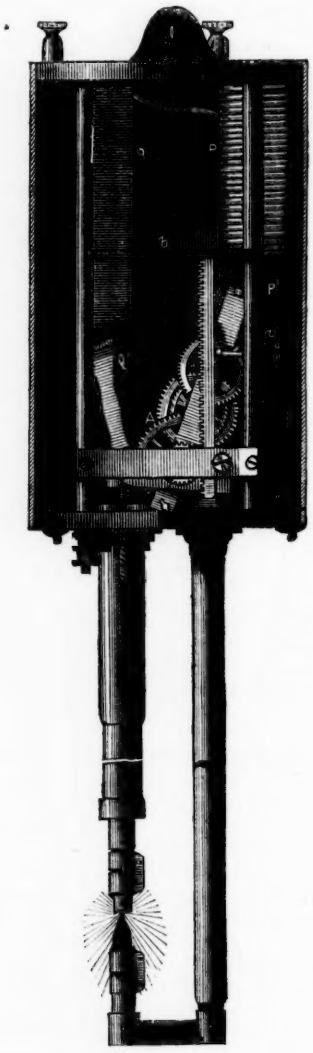
of motion, so that in turning slowly on disengagement, this arbor immediately returns the stop to the position of engagement. In this way the carbons only travel an imperceptible distance at a time and at very short intervals.

A screw serves to regulate the distance at lighting, and another screw, which stretches more or less the counter-spring of the armature, Q^1, serves to keep this arc at the desired length.

In the first case, the cover of the regulator being raised, we raise the upper carbon-holder; then, whilst it descends with its rod, we regulate the height of the screw forming a stop at an angle from the armature, Q^1, so that there exists between the internal surface of the electro-magnet, P, and of the end of the armature, P^1, a distance of 12 to 13 mm. for the Gramme 5-light machine, and from 18 to 19 mm. for that of the workshop type.



In the second case, the distance of the carbons is regulated during the working of the lamp. This distance ought to be for the two machines mentioned $2\frac{1}{2}$ mm. and 4 mm.

At the time of regulating, when the distance is too great, we loosen the nut on the screw, to which is attached the spring of the armature, Q^1, in order to relieve slightly this latter; on the contrary, if the distance is too small, we tighten this spring until the steadiness of the arc be obtained.

This lamp has worked for some time already in a very satisfactory manner in various manufactories, namely, in Belgium, in the environs of Liége and of Charleroi. We will mention, among others, the installations which have been made under the superintendence of M. Jaspar in the Cockerill establishment, the locomotive manufactory at St. Léonard, the works of Messrs. Fétu & Deliége, the ironworks of M. Gilliaux, at Charleroi, &c.

ELECTRIC LIGHTING FOR PICTURE GALLERIES.*

MOST people know that there are two distinct methods of lighting by electrical means: the arc system, giving that peculiar form of illumination which is generally called "electric light," and the incandescent system, which gives a light more like the best forms of gas or oil lighting. In considering the subject of how best to light our picture galleries by electrical means, we may well begin by considering which system gives the kind of light best suited to our purpose. I unhesitatingly say that the arc system is really the best from this point of view. I know that to most people—I have myself been subject to the illusion—the light from an arc lamp is hard, cold, ghastly; objects look strange, women look like corpses, their dresses look hard, cold, and ill-arranged as to colour. In truth, the light from an arc lamp is not a ghastly blue, but a pure white; it cannot be distinguished from the light reflected from a white cloud in the north, the light of all others most liked by painters. It in no way alters colours from the shade and tone which they have by day. This is proved to demonstration by the fact that haberdashers and silk mercers can match—so that the match will stand by daylight—the most delicate shades by the aid of the arc light, and by no other kind of artificial illumination. The reason of the prejudice against this beautiful light is not far to seek. We have all been accustomed to a very yellow form of artificial light, so that our brain automatically applies a correction to what we see whenever we know that we are looking at objects illuminated by artificial light; and this correction is still made with the arc light, although it is no longer required. After a few evenings spent in a building lighted by it the illusion disappears, and we are able to enjoy the delight of daylight by night. But until the public at large have been trained to like, instead of hate, the arc light, it would be extremely unwise to introduce it into a picture gallery. We must therefore fall back upon the incandescent plan.

There are many lamps on this system which are now before the public, and they show great differences in the quality of the light they give. The first point in lighting a picture gallery is to carefully select the lamp which gives the whitest light. There is as yet no chance of finding an incandescent lamp giving so white a light as to give rise to the illusion produced by the arc lamp. The whitest light attainable is almost white enough not to produce serious modification of strong colours. I should, however, think that those lamps which give a decided yellow or even slightly orange light would never illuminate pictures so as to produce a satisfactory effect upon a trained eye. In arranging, it would be well, if possible, to conceal the lamps themselves from view. It is always well that the actual source of light should be invisible, and it becomes of even greater importance when incandescent lamps are used. The reason is, that as yet they are curiosities to most people, who delight in staring at them, and thus fatigue their eyes so much that if afterwards they looked at pictures they would probably see them covered with black shifting images of the carbon filaments used in the lights. Probably one of the best forms of illumination will be obtained by a string of lamps near the ceiling, some feet from the wall, with a screen behind them painted white with some dead-surfaced pigment, and sufficiently deep to hide them from the spectator. A good effect would be produced in the case of a large picture by placing before it at a distance of about two feet, a large frame blackened on the side next the spectator, and studded all round on the side next the picture with small incandescent lamps. It must always be borne in mind that a better effect, and, indeed, more light where we want the light, is often to be got from several small lamps than from one large one. Thus, it is often better to employ four five-candle lamps than one twenty-candle lamp.

The reasons why this form of lighting should be introduced without delay into picture galleries appear to me to be very strong. First, if the arrangements are carried out properly, there is *no danger from fire at all.* Then, the lamps being hermetically sealed, no gas or vapour escapes into the air, so that neither pictures nor frames can suffer; whilst the air of the gallery remains fresh and pure. And,

* Mr. Gordon Wigan, M.S.T.E., in *Magazine of Art* for July.

lastly, the heat thrown out is so small that they may be put as close as may be necessary to pictures, walls, or drapery. To get the best possible lighting, it would be unwise for the director of any picture gallery to select any "system" for himself. He should apply to some competent electrical engineer, who is not tied down to the use of any particular patent or patents, and get him to supply all that is wanted. Nor need he fear that any great expense will be incurred should the first arrangement be unsuccessful. Almost endless arrangements may be tried if the main "leads" or conductors are intelligently placed, at but little more than the cost for the labour of shifting the lamps from one form of grouping to another. This has been practically proved in certain private houses, where redistribution has been practised from day to day, until the right arrangement was hit off.

The question of working expenses is one of some importance. It will be generally necessary to use some form of engine, and a dynamo machine at the gallery itself, and the interest on the capital thus expended must add to the cost. But even then it would be quite possible, by using a gas-engine, to light the gallery at something under twice the cost of gas-lighting. Where there is spare steam-power on hire hard by the cost would be much less. And any director who was fortunate enough to find natural water-power near his gallery would probably be able to light his pictures electrically at much less than the cost of gas. Even where the cost is double that of gas, the safety from fire, and the length of time that ceilings and decorations will last without renovation, would most likely more than cover the difference in price. As to the mechanical power required, it is estimated that up to about thirty lights, one horse-power is required for each ten lamps of sixteen candle-power each; above that limit rather more lamps can be kept shining for each horse-power.

The cost of production of energy varies. For natural water-power it is nothing. Large steam-engines only consume between two and three pounds of coal per horse-power per hour; small steam-engines are less economical. The gas-engine, which does not require skilled attendance, costs in working about one penny per hour per horse-power. Gas-engines, however, have this disadvantage, that the larger ones require about two men to start them. Of course, if after a private set of plant has been set up a lighting company brings its mains near the gallery, the problem will have to be solved whether it is cheaper to produce the current on the premises, or to put up with the loss on the sale of the plant and take the current from the company's mains. The solution of this problem involves the price which the company proposes to charge. If the companies should be so ill advised as to charge the maximum price to be found in most of the Provisional Orders, or any price but little under this maximum, it will be much cheaper in the long run to erect every man his own gas-engine and dynamo, and generate his own current. I assume that the lights are only used for four hours a day all the year round, the economy of home manufacture increasing with the number of hours during which the lights are used, and farther with the number of lights to be used. So that the picture gallery with some hundreds of lights would be lighted at a cheaper rate per light than a private house with twenty or thirty lights.

As soon as the present prejudice against the arc light is overcome, should there be no light of the same quality to be produced by other means, arc lighting will have to be adopted. Now arc lights of less than several hundred candle-power are not likely to be produced economically at present, about 800 to 1000 candle-power is the smallest arc light worth considering. Just now we can only get a sufficient diffusion of light by giving up the use of the direct rays and by using light reflected from a rough white surface. The loss of light by this method is very great; but it must be remembered that about two hundred candle-power per horse-power is all that has as yet been obtained in practice from incandescent lamps whilst 1000 to 1500 candle-power per horse-power can easily be obtained from arc lamps. But before arc lighting can be applied successfully to the illumination of pictures we must not only get rid of popular prejudice, but the lamps themselves must be improved. With the exception of one or two new types, which are as yet on their probation, arc lamps give a light which is unsteady in quantity and variable in colour. Should progress not lead to the extinction of the arc system by improvement in the incandescent system, arc lights of perfect steadiness will be produced. There would still be precautions to be taken before introducing them into art collections. Ordinary arc lamps burn in the surrounding air, and pour into it oxides of carbon, which are bad to breathe, and measureable quantities of ozone and nitric acid, which have a strong tendency to spoil metals and colours. An arc light loses but little and gains much by being shut up in an hermetically closed lamp; but very few of these have been devised, and as this is so, the risk of exposing works of art to the fumes of an arc lamp is one which ought not to be run.

It may, perhaps, be noticed that up to this point I have said nothing about the so-called semi-incandescent systems of electric lighting. My reason is that I could better discuss them when considering pure arc lights. All semi-incandescent lights depend partly on small voltaic arcs, and have, in consequence, the defect of throwing off vapours of a more or less deleterious kind, and lend themselves less readily than pure arc lights to being shut up in closed globes. Whether we take the Joel, the Werdermann, or the beautiful and cheap Lampe-Soleil, we get a very steady light midway in economy between the pure arc and pure incandescent systems; but as a rule the light is rather yellow. Unless I am greatly mistaken, in a very few years, as incandescent lighting gets more economical and arc lighting more steady, these semi-incandescent lights will be selected out of the struggle for existence. Even at present, for picture lighting purposes, they cannot be easily arranged to give light by reflection; and as to get them to work economically they need to have a rather high candle-power. I confess that I think it would be difficult to get a good uniform distribution of light by their use.

ELECTRICAL TRANSMISSION OF POWER.

APPLICATION AT THE PÉRONNIÈRE MINES.

THE Péronnière installation consists of:—1st. A receiving Gramme machine, working a truck placed at the head of an incline 105 mètres long, with a rise of 40 mètres, by which the coals are raised. 2nd. A second receiving Gramme machine, placed at the top of a shaft and working a pulley which winds up a steel rope, carrying at one end a cage and full basket and at the other a counterpoise. The vertical distance which the cage travels is 26 mètres.

The first truck is 1,200 mètres distant from the source of electricity; the shaft is 1,500 mètres from the same source.

Table I.—Experiments made for the Determination of the Power required for the Passive Resistances.

Number of the experiment.	Conditions of the experiment.	Engine-power per second.	Electromotive force, E.	Intensity, I.	Speed of the generator.	Disposable power, $\frac{EI}{9}$
		kgm.	volts.	amps.	revs.	kgm.
1	Steam-engine alone ...	228·7	—	—	—	—
2	Steam-engine with the connecting gear ...	396	—	—	—	—
3	Steam-engine with connecting gear and one generator	455	—	—	1,280	—
4	Steam-engine with connecting gear and two generators	508	—	—	1,280	—
5	Steam-engine with the inclined-plane generator and motor (closed circuit)	723	114	4·02	1,280	46·7
6	Steam-engine with the inclined-plane machines and empty baskets on each rope (average of four experiments) ...	932	256·4	12·1	1,280	316·65
7	Steam-engine with the shaftgenerator and motor (closed circuit) ...	586	80	2·3	1,280	18·7
8	Steam-engine with truck without cable	657	148·8	4·6	1,280	69
9	Steam-engine with empty baskets at the incline plane, and truck without rope at the shaft ...	1,144	139·2	4·6	1,280	65

Two series of experiments were made. The object of the first was to establish as nearly as possible the power required for the passive resistances. In the second, trials were made to determine the power obtained under various conditions of working.

Table I. gives the results obtained in the first series of experiments.

Table II. shows the results of seven experiments made under various conditions.

The four first experiments refer only to the machinery at the inclined plane, the fifth to that of the shaft, the two last refer to the motors at the inclined plane and at the shaft combined.

Table II.—Experiments made upon Electrical Machinery at La Péronnière.

Number of the experiment.	Conditions of the experiment.	Engine-power per second.	E.	I.	Speed of the generator.	Speed of the motor.	Weight raised.	Height.	Duration of the experiment.	Total useful work.	Useful work per second	Rendering.	Work on the axle of the generator.	Rendering.	$\frac{E \times I}{g}$.	e.
		kgm.	volts.	amp.	revs.	revs.	kg.	mètres.	sec.	kgm	kgm.		kgm.			volt.
1	Machines with one full basket raised up the inclined plane	1241	320	15	1280	1102	399	40	96	15,960	166	0·134	786	0·211	489	..
2	Machines with two full baskets raised up the inclined plane	1429	400	19	1280	1050	798	40	105	31,920	304	0·213	974	0·312	775	..
3	Machines with three full baskets raised up the inclined plane..	1657	425·6	21·3	1280	969	1200	40	110	48,000	436	0·263	1202	0·362	924	348
4	Machines with four full baskets raised up the inclined plane	1928	436	25·7	1280	912	1597	40	120	63,880	532	0·275	1473	0·361	1142	..
5	Engine, generator, motor, and one full basket at the shaft	1672	372	19·3	1280	..	627	26	36	16,302	453	0·270	1217	0·372	732	298
6	Engine with two generators and two motors	2786	360	21·4	1280	969	..	..	..	..	843	0·302	2278	0·370	1709	..
	Three baskets raised up the inclined plane	..	..	..	..	..	1200	40	110	48,000	..	..	..	..	..	..
	One basket raised in the shaft	..	..	..	..	..	627	26	40	16,302	..	..	..	..	..	..
7	Engine with two generators and two motors	3294	400	21·4	1280	912	..	..	..	..	939	0·285	2786	0·337	2015	..
	Four baskets raised up the inclined plane	..	..	..	..	..	1597	40	120	63,880	..	..	..	..	..	..
	One basket raised in the shaft	..	..	..	..	..	627	26	40	16,302	..	..	..	..	..	..

We see that the relation of the useful work per second to the steam-power in the cylinder gives for the practical rendering :

	Per cent.
Raising 1 full basket up the inclined plane	13·4
,, 2 full baskets ,, ...	21·3
,, 3 ,, ,, ...	26·3
,, 4 ,, ,, ...	27·5

The rendering, therefore, increases with the load.

In the case of the shaft, working alone with one basket, we have a rendering of 27 per cent. The work, in this case, corresponds to the work in the inclined plane when three baskets are raised.

When both trucks work at the same time we obtain :

	Per cent.
In the first case	30·2
In the second case	27·8

These results show us that the rendering attains the maximum in the conditions of working stipulated for experiment No. 6. This maximum, which was obtained with an invariable speed of the generator, that is to say, 1,280 revolutions per minute, could be exceeded by giving the generator greater velocity.

Lastly, grouping the results obtained from experiment No. 6 (Table II.), which gives the conditions of working in the Péronnière installation, we have a rendering :

Of 30 per cent., taking the relation of the useful work to the steam-power in the cylinder ;

Of 37 per cent., taking the relation of the useful work to the work upon the axle of the generator ;

Of 49 per cent., taking the relation of the useful work to the work $\frac{Ei}{g}$ actually disposable on the generator.

For the rendering from machine to machine, we have the following :

50 per cent, taking the relation of the actual work of the receiver to the work upon the arbor of the generator ;

67 per cent., taking the relation of the actual work of the receiver to the work $\frac{Ei}{g}$ actually disposable upon the generator.

To calculate the rendering the following equations may be generally used, viz. :—

$$\frac{ei}{Ei}, \frac{T_u}{T_u}, \frac{ei}{T_a} \text{ and } \frac{T_u}{Ei},$$

which give very different results ; this may be seen by comparing the number obtained in the case of the experiment No. 3 of Table II., thus we have :

$$\frac{ei}{Ei} = 0{\cdot}82, \frac{T_u}{T_u} = 0{\cdot}53, \frac{ei}{T_a} = 0{\cdot}60, \frac{T_u}{Ei} = 6{\cdot}67$$

The two first equations alone give comparable results, the first when electrical installations have to be compared with electrical installations ; the second when the rendering obtained by electrical transmission is to be compared with the renderings obtained by the employment of another kind of transmission.

The two last give results which relate directly to the electrical rendering and the mechanical rendering ; if employed they would give very erroneous results.

ei represents the disposable work at the terminals of the receiver ;

Ei the disposable work at the terminals of the generator ;

T_u equals the useful work plus the work required to overcome the passive resistances of the truck and the friction of the baskets upon the ground.

T_a equals the work furnished by the motor at the axle of the generator.

Giving to the letters the values indicated in Table II., experiment 3, we get

$$\frac{ei}{g} = 756, \frac{Ei}{g} = 924, T_u = 645, T_a = 1{,}202.$$

The work given by the steam-engine upon the axle of the generator is employed to raise the useful load, which is 436 kilogrammes, to overcome the passive resistances of the truck, which have been estimated at 209 kilogrammes, and moreover to overcome all the resistances peculiar to the system of transmission. We may therefore suppose—

$$1{,}202 = 436 + 209 + T_r = 645 + T_r \qquad (1.)$$

T_r representing all the losses by electrical transmission comprised between the axle of the generator and the axle of the receiver.

On the other hand, we have :—

Subtracting equation (2) from equation (1) we have—

$$\frac{Ei}{g} = \frac{Ri^2}{g} + \frac{ei}{g} \qquad (2.)$$

$$\left(1{,}202 - \frac{Ei}{g}\right) = 645 + Tr - \frac{Ri^2}{g} - \frac{ei}{g},$$

whence :

$$Tr = \left(1{,}202 - \frac{Ei}{g}\right) + \frac{Ri^2}{g} + \left(\frac{ei}{g} - 645\right).$$

We see that the total loss of work resulting only from the electrical transformation may be summed up as follows :—

$\left(1{,}202 - \frac{Ei}{g}\right)$ loss in the generator from many causes, and chiefly from the resistance of the current in the bobbin and in the electro-magnets.

$\frac{Ri^2}{g}$ loss in the conductors.

$\left(\frac{ei}{g} - 645\right)$ loss in the receiver.

These results, in the particular case under consideration, show :—

1st. That the work, $\frac{Ei}{g}$, disposable at the terminals of the generator is only 0·76 of the work supplied by the steam-engine to the generator.

2nd. That the passage of the current through the conductors which connect the two machines absorbs $\frac{Ri^2}{g}$, so that, if we measure the work at the opposite end of the conductors, that is to say, at the terminals of the receiver, we find that the work, $\frac{ei}{g}$, disposable at the terminals of the receiver is only 0·82 of the work, $\frac{Ei}{g}$, disposable at the terminals of the generator.

It is this equation

$$\frac{ei}{Ei} = 0{\cdot}82$$

which gives the electrical rendering of the machines.

3. The work $\frac{ei}{g}$ measured at the terminals of the receiver is not utilised only by the truck ; a portion of this work is absorbed by the rotation of the bobbin upon its axis, and by the resistance which the current encounters in the brushes and in the bobbin. Thus the work utilised by the truck is only 0·85 of the work $\frac{ei}{g}$ disposable at the receiver.

Comparing the values of T_u and of $\frac{ei}{g}$ with the work which one would obtain by placing a brake upon the axle of the bobbin of the receiver, we see that this work would be much greater than T_u and less than $e\,i$, for it comprises in addition to T_u, the work absorbed by the rotation of the bobbin upon its axis, and less than $e\,i$, the work absorbed by the resistance of the current in the wires of the bobbin and electro-magnets.

The work obtained upon the axis of the bobbin by the brake would give a rendering $> \frac{T_u}{T_a}$ and $< \frac{ei}{T_a}$ that is between 0·53 and 0·60.

These losses arise from various causes and are imperfectly understood. Electricians have proved their existence like we have ; but up till now they have devoted all their attention to insuring the good working of the machines, and they have neglected the study of arrangements which might augment the rendering a little. Now they have little to do to render the use of electrical machinery easy.

We may hope that, in devising new electrical machines, they will seek for the causes which produce the losses which we point out, in order to cause them to disappear in part if possible.

The determination of the exact value of these losses is doubtless very important in theory and practice ; it may moreover serve to render the calculation of the mechanical rendering very easy and very accurate.

In fact, the mechanical rendering $\frac{T_u}{T_a}$ (which is obtained by neglecting all the losses arising from the electrical machines and the conductors, and which is the only one useful to know, because it serves for comparing the renderings obtained by the employment of electrical transmissions with the renderings obtained by the employment of other transmissions) may be determined in the following manner :—

If we return to the results of our experiments we have—

$$\frac{Ei}{g} = 0{\cdot}76\ T_a$$

whence—

$$T_a = \frac{Ei}{g \times 0{\cdot}76}$$

We have also—

$$T_u = 0{\cdot}85\ \frac{ie}{g}$$

and the equation—

$$\frac{T_u}{T} = 0{\cdot}76 \times 0{\cdot}85 \times \frac{ei}{Ei} = 0{\cdot}64\ \frac{ei}{Ei}$$

and as on the other hand—

$$\frac{ei}{Ei} = 0{\cdot}82$$

we find—

$$\frac{T_u}{T_a} = 0{\cdot}64 \times 0{\cdot}82 = 0{\cdot}53$$

By numerous experiments we have determined these losses, and consequently the co-efficient by which we should multiply the equation—

$$\frac{ei}{Ei}.$$

If we succeed in demonstrating that the co-efficient is constant for a given type of machine, the calculation will be very simple. If the co-efficient is variable we shall have to establish the law of the variations from equation to equation of the electromotive force, $\frac{e}{E}$.

In summing up it is ascertained that for a given work there corresponds an intensity which remains the same as long as the work remains constant. If, at the same time as we observe this intensity, we take at the two terminals of each of the machines the differences of potential E and e, we shall have very accurately the disposable work at the terminals of each of the machines and consequently we can calculate very accurately the electrical rendering, $\frac{ei}{Ei}$.

In order to obtain the mechanical rendering it will suffice to multiply this equation by the co-efficients corresponding to each type of machines.

If the co-efficients are not constant, it will be necessary to take the co-efficients corresponding to the equation, $\frac{e}{E}$ which we shall determine at the time of the experiment.

In conclusion, in our particular case, the distance between the two machines being 1,200 metres, the receiver utilised one-half of the work supplied to the generator by the steam-engine.—*M. Charousset in "l'Electricien."*

Gallant Rescue.—At Valentia, Ireland, on the 26th ult, a little boy, 5 or 6 years old, named Michael Cremin, son of the hotel proprietor, accidentally fell over the pierhead into the water, and was rescued by Mr. Daniel Herbert, one of the staff of the Anglo-American Telegraph Company, who plunged into the water in a rapid tidal way, brought the child up from the bottom, and swam ashore with him.

THE FIRST AND TRUE INVENTOR.

IN connection with the bills now before the House of Commons for the amendment of the law relating to letters patent for inventions, a strong feeling has been expressed for the abolition of declarations such as are now required to be made by applicants for patents, to the effect that they believe themselves to be the "true and first inventors" of the inventions in respect of which the applications are made.

This expression of feeling may no doubt be considered as one exponent of a widespread movement which prevails, having for its object the dispensing altogether with oaths, affirmations, and declarations; but without going into the general question of the necessity or expediency of such asseverations, my own experience is decidedly in favour of the retention of the declaration now required to enable an inventor to obtain a patent.

That the declaration is not considered or treated in every case as a meaningless form of words will be evident from the following circumstance which came under my own observation. Some years since a gentleman consulted a patent agent in reference to an alleged invention for which he wished to obtain provisional protection, but the subject of which I conceal for obvious reasons. Having great doubts of the novelty of this supposed invention, the patent agent recommended a search; but finding that the applicant was not willing to have the necessary complete investigation made, he volunteered to refer at once to some documents in order to discover if possible an old specification which he believed, from his recollection of its contents, would seriously affect the validity of the proposed patent. The response of the *soi-disant* inventor was somewhat startling, and evinced a skill in casuistry worthy of the most profound student of that interesting branch of ethics. "No," said this gentleman, "I have no doubt you are quite right that there may be some anticipations; but I should much prefer for you not to show them to me now, as if I were to see them *I should not be able to take the oath*"—(meaning make the usual declaration)—"*let me take the oath first.*"

Now, here was a man who did not scruple to apply for a patent for purely commercial purposes (one proof of the necessity for a stringent examination of applications for which I have so long contended), but found the declaration lie heavy on his conscience so that he felt he could not comfortably subscribe to it if the anticipatory specification had been brought under his notice.

I grant that the public did not gain much advantage in this instance by this gentleman's scruples of conscience, but the circumstance, at any rate, shows the feeling of sanctity which attaches to the declaration, and I certainly think it would be exceedingly unwise to remove this safeguard, such as it is.

While, however, I express a strong opinion in favour of the retention of the declaration, I would not be understood as implying that it is always made with the honesty and sincerity which are desirable. I know, indeed, that such is very far from being the case. I could point to an article of general use, the monopoly of the manufacture of which has been protected by a host of patents which were taken out by the principal of a firm who made solemn declarations that he was the first and true inventor, although the inventions so protected were wholly due to his *employés*.

An equal amount of laxity frequently prevails with regard to affidavits in patent suits. Some time since, a gentleman who was requested to make an affidavit on behalf of a defendant to an action for infringement, proposed to go to the Patent-office and search for some anticipations upon which to base his affidavit. "No," replied his adviser; "make your affidavit first and search for something in support of it afterwards!"

Notwithstanding, however, any exceptions which may be met with, I still hold to the utility of declarations. The fact that some persons abuse them does not prove that it is desirable to abolish them altogether, unless we are prepared to admit that a law is to be abrogated on account of some infractions of it. The declaration exercises a wholesome check in many instances, and it is to be hoped therefore that the legislature will not sanction the removal of this restraint, but, on the contrary, will make it still more stringent if necessary, and visit falsity with condign punishment.

T. J. HANDFORD.

THE APPLICATION OF ELECTRICITY TO MEDICAL PURPOSES.

WE have been favoured with several papers dealing with the above subject since we made our comments a fortnight since on the article by Dr. Stone, entitled "The Electrical Resistance of the Human Body." From these papers—for which we have to thank Mr. A. de Watteville, M.A., B.Sc.—we shall make a few extracts, which will probably be found interesting at least, to many of our readers, and valuable to others. In the "Proceedings of the Royal Society," No. 222, 1882, was published an article by the above-named gentleman and Mr. A. Waller, M.D., on "The Alterations of the Excitability of the Sensory Nerves of Man by the Passage of a Galvanic Current." We reproduce a small portion of this in order to show the precautions observed by the authors when experimenting on the human body.

"The methods we employed were precisely the same as those used for the investigation of the excitability of the motor nerves.* One electrode of small size—the exploring electrode—was fixed over the nerve chosen for the experiment; whilst the other electrode, of large size, rested on a distant part of the body. In order to secure the coincidence of the zones of polar alteration and of stimulation, the polarising and testing currents were united in the same circuit.

"This is effected, when the induced current is used for testing the excitability, by including the secondary coil in the circuit of the polarising battery. When galvanic makes and breaks are so used, the current of the testing battery is thrown into the circuit of the polarising current without breaking the latter, by means of the double key of Helmholtz arranged in the usual manner.

"The precautions we took for the elimination of errors arising from changes in the resistance of the body and in the current strengths during the experiments were either:—1st. The galvanometric control of the currents used; 2nd. The intercalation of large additional resistances in the circuit (viz., 10,000 ohms, which is about eight times the resistance of the human body under the conditions of our experiments). The influence of any changes in that resistance would thereby be diminished in the same proportion."

In another article, taken from Mr. de Watteville's book, "Introduction to Medical Electricity," we note the following remarks on "The Human Body as a Conductor," and we think that the observations we made in our issue of June 23rd will be fully borne out by the experiments here reproduced.

"*Experiment.*—Take a battery with galvanoscope in circuit, and choosing a convenient electromotive force (ten Leclanché cells answer the purpose very well), note the deflection of the needle obtained when two medium sized electrodes, moistened with cold water, are applied to two given spots on one side of the body, 1st, at the moment of application; 2nd, after the electrodes have been kept *in situ* for five minutes. The deflection in the latter case is greater, which means that the current is stronger because the resistance of the epidermis has been diminished by the moisture of the electrodes. Repeat the experiment on the symmetrical points of the other half of the body, with the electrodes soaked with hot salt and water. The deflection is greater at first, and soon reaches a greater maximum than before, because the penetration of the fluid into the skin is more complete and rapid. Note also the fact that the current is stronger when the electrodes are applied firmly to, than when they are made to touch lightly, the surface of the body.

"*Experiment.*—Take a pair of the different sized electrodes (fine, small, medium, large, very large), and apply them successively to the same two spots with the same electromotive force (10 cells) in circuit. The galvanometric deflection increases with the size of the electrodes. Repeat the experiment taking the electrodes in the opposite order, so as to eliminate the fallacy arising from the increased moistening of the epidermis; and take care that, throughout, the electrodes be uniformly soaked. The skin forming the chief resistance of the circuit, every increase in the area it offers to the entrance of the current is accompanied with a considerable increase in the total current strength.

* "Proc. Roy. Soc.," vol. xxxiii., p. 353; and "Phil. Trans.," 1882, p. 961.

"*Experiment.*—Take two medium-sized electrodes and with 10 cells in circuit observe the deflections you obtain when they are applied to a number of symmetrical points on the face, neck, trunk, and extremities. You will find that the deflections vary greatly. The experiment must be made carefully; the electrodes are to be moistened again each time they are applied, and each time left *in situ* for a given number of seconds. That these differences are due chiefly to the varying skin-resistance can be demonstrated by repeating the experiment with needles thrust into the subjacent tissues (as is done in the treatment of rheumatism, paralysis, &c., by acupunction), and noting the deflections given with one or two cells in circuit.

"*Experiment.*—Apply a large plate electrode to the nape of the neck, and when the skin underneath it has been thoroughly soaked apply the other electrode (small or medium size) to a series of points along the trunk and limbs, taking the same precautions as in the former experiment, note the deflections obtained in each case. You will find that they vary not according to the distance between the electrodes but according to the point touched with the movable one. The substitution of a needle for the latter, or the occurrence of superficial ulcers or excoriations, will serve to show that the variations observed depend upon different skin resistances at different points of the body.

"It is of great service in the electrisation of the human body for diagnostic or therapeutic purposes, to be familiar with the relative resistance encountered by the current, at different points of its surface. Such a familiarity will speedily be obtained by systematically observing the deflection of the needle, under varying conditions of experimentation. Though a galvanoscope is sufficient to demonstrate the existence of great differences between the body resistances, the observer will be greatly assisted in realising the facts by using a galvanometer divided into units of current strength, which allows him to compare these resistances with one another, and a rheostat which enables him to measure them.

"Looked upon as a conductor of electricity, the human body may be compared to a vessel bounded with poorly conducting material (the skin) unequally packed with non-conducting solid particles, the interstices being filled up with a saline fluid of fair conductive power. The parts most densely packed with solid particles are represented by the bones; those where liquids predominate, by the muscles. between the two are found the nerves, viscera, &c. The contents of the blood-vessels are the best conducting media in the body. In short, the list of the various tissues arranged according to their watery constituents, may be considered as classifying them according to their electrical conductivity. The diffusion of electrical currents in such a conductor is evidently very irregular, and impossible to represent accurately either by word or drawing. It has no specific resistance, nay, it is impossible to define accurately the specific resistance of any one of its component parts, whether nerve, bone, or muscle, &c. The unequal distribution of blood among them, their complex structure (not to speak of their unequal internal polarisation), makes any statement concerning their resistance subject to variations within wide limits.

"The chief resistance of the skin is located in the epidermis, which when dry is to be considered as an insulator. The epidermis, however, varies in thickness at different points of the body, and is not continuous, being perforated more or less thickly with the outlets of sweat-glands and follicles. Its resistance diminishes in proportion to the degree of its moisture (artificial soaking, perspiration). The increased vascularities of the underlying cutis has probably some influence in reducing the resistance of the integuments.

"The resistance of the skin varies accordingly, to a prodigious extent, not only between different individuals and between different parts of the body of the same individual, but at the same points of the same individual under different conditions.

"Some minor points have to be taken into consideration with reference to the altered resistance of the epidermis, through its permeation with water. Hot salt water reduces this resistance more than pure cold water. The cataphorical property of the current, and perhaps also its influence on the cutaneous vessels have the effect of reducing it still further than mere soaking. (The effect of a current on the deeper tissues—polarisation—which is manifested on reversing it after it has flowed for a time, will be best considered along with its physiological effects.)

"A most important conclusion to be drawn from the fact that the skin, even under the most favourable circumstances, offers the chief resistance to the current, is that the size of the electrodes, that is to say, the extent of the body-surface offered to the current as spots of inlet and outlet, to a great extent determine the strength of the current obtainable from a given number of cells, through the body. The resistance of a conductor, we know, varies inversely with its diameter; hence by doubling, trebling, &c., the size of the electrodes, we shall diminish the resistance of the skin 2, 3, &c., times. Now since this resistance forms the greater part of the total resistance in the circuit, it is obvious that its diminution will be of great influence on the strength of the current. If we assume the resistance of the skin to be 100 times greater than that (R) of the rest of the circuit (battery, electrodes, internal tissues of body), the current strength, according to Ohm's law, will be given by the equation

$$\frac{E}{100\,R + R}$$

where E is the electromotive force in circuit.

"It is obvious that by diminishing the resistance of the skin by one half, we shall increase the current in the proportion of 1 to 2 nearly for

$$\frac{\frac{E}{100\,R + R}}{2} : \frac{E}{100\,R + R} = 51 : 101.$$

These numbers are not meant to represent the facts, but merely to illustrate the principle involved in the problem.

"The above discussion may be conveniently summed up in the following statement.

"'The resistance of the human body' when put forth as a general statement is a meaningless expression. By it, is to be understood chiefly the resistance of the two particular portions of the skin in contact with the electrodes under the conditions of the particular application; the resistance of the intermediate portion of muscle or other tissues (except bone) being almost negligible in comparison to the former, partly owing to the better conductivity of these tissues, partly to the large sectional surface they offer to the flow of the current. The resistances of the body will vary not so much according to the distance of the electrodes from one another, as according to their diameter, the degree of moisture of the epidermis, its thickness at the point of application, the number of sweat ducts offered to the current, and the state of the cutaneous system, and to a certain degree, with the strength and length of the electrical application. Pressure on the electrodes diminishes the resistance.

"These considerations help to explain the prodigious discrepancies between the numbers ascribed by various observers to 'the resistance of the body.' The numbers given in every instance can apply only to the particular parts of the body of the particular individuals, tested under particular circumstances; when, therefore, we read or say that 2,000 or 3,000 ohms may be assumed to represent the average resistance of the parts of the body when galvanised with medium electrodes according to the polar method adopted in ordinary medical applications no practical importance, except from the most general point of view, can be attached to statements of this kind, which are used for the purpose of argument and illustration only. Variations ranging between 1,000 and 10,000 ohms, are by no means rare under those very conditions."

It will be seen from these interesting experiments and the observations following them how careful the medical practitioner should be in making electrical tests, and we feel more than ever convinced that our strictures on Dr. Stone's paper will meet with approval by the majority of medical men who find it necessary to employ electricity as a curative agent in many of the cases submitted to them. We should imagine that Mr. de Watteville does not hold the opinion that change of temperature is the cause of resistance variation in the human body, which certainly cannot be looked upon in the same light as a solid and metallic conductor.

MILITARY TELEGRAPHS DURING THE AMERICAN CIVIL WAR.*

AT a first glance it may seem rather a late date, after an interval of 18 years of peace, following the most embittered of wars, for W. R. Plum to have made the history of the American military telegraphs the subject of a special work, entitled "The Military Telegraphs during the Civil War in the United States," published by Jansen, McClury & Co., Chicago. The two volumes of 767 pages, contain much that has hitherto been unpublished, and not only furnishes the historian with abundant material, but are of special value to the student of military telegraphy. Telegraphic operations were carried out in this war on a more extensive scale than has ever been done in other cases, even in the most modern wars. The field telegraph officer and the stragetist may learn from Plum's work that the military telegraph can be employed not only between the headquarters of advancing armies, but also for the conveyance of information and orders to and from the front during reconnoitring operations and whilst in action.

The opinion, supported as yet by comparatively few officers in European armies, that telegraphic transmission of orders, &c., can be used with advantage in tactical operations, should find but few opponents in face of the fac s here revealed, and if experiments made during manœuvres have here and there given results which seem to contradict this opinion, the question should not be considered as settled, as it remains to be considered whether the *personnel* had been properly chosen and organised, and whether it had the necessary experience. Telegraphy at the front requires the most experienced men as operators and fully competent officers who have no other duties to perform, for with non-experienced telegraphists success is not to be expected. The Federals fully proved this during the war.

The principal object of the author, however, is to procure recognition and justice, which, unpardonably and strangely enough, have not yet been accorded by the Government of the Republic to the Military Telegraph Corps of the United States, which took so important a part in the success of the four years' war. In this endeavour the author brings forward a mass of data, the historical value of which may be easily recognised from the fact that it contains telegrams from the President, the ministers, and the commanding offiers, which are not even to be found in the Government archives.

The author took part in the campaign as a Federal military telegraphist, and is therefore in a position to speak from personal experience. His present position as a barrister of high standing in Chicago exonerates him from all personal interest in his criticisms of the American field telegraph service, and of those individuals who in its organisation have won historical fame and the gratitude of all their compatriots. Amongst these, Anson Stager is particularly conspicuous as chief of the military telegraph, for to him belongs the fame of having created a telegraph corps, which fulfilled in a highly satisfactory manner the most trying demands which have ever been made on such a corps by any army.

At the outbreak of the war there existed in the United States army a small body constituting a so-called "signal corps," which used only optical signals, but the Federals on their part at once formed a military telegraph corps, which was recruited from the ranks of the civil telegraphists. The material for the first requirements was taken from the telegraph companies, and the existing lines were used for military purposes. The necessity for telegraph connection between the various army corps, the war ministry and the country, declared itself at the outburst of the war, and the military telegraph corps was thus created in a moment of need; it was accepted by the Minister of War, without, however, being confirmed by Congress. In this anomalous position lay the germ of the grievances of the corps, which the author by the publication of his work is endeavouring to remove.

The Military Telegraph Corps accompanied General McClellan's division, for the first time, on his march from Clarksburg to Buckhannon, in the beginning of July, 1861, and the general staff declared itself at once in favour of telegraphic communication. At Richmountain, on the day of the battle, a field telegraph station was opened, which contributed in no small degree to McClellan's victory, and to the defeat of Generals Garnett and Pegram, by expeditiously conveying orders and enabling troops to be forwarded at the right moment. When McClellan extended his operations over the states of Missouri, Illinois, Indiana, Ohio, and West Virginia, the military telegraph alone rendered it possible to command with facility troops scattered over such an extensive territory.

The corps had no real military organisation and consisted of civilians. In August, 1861, General Fremont made an attempt to organise a military corps, to be led by General Smith, with a view to extending communication to the battlefield. The telegraph battalion was formed of experienced telegraphists; it consisted of three companies, and numbered altogether 86 men: 74 privates, 8 corporals, 2 lieutenants, 1 captain, and 1 major. This battalion was in active service up to November and was then disbanded by order of the Minister of War, as General Fremont had not applied for consent to the formation of the corps. General Sickle also formed a telegraph company, constituted of men who had volunteered for three years military service, which was known as the "Chester Telegraph Corps."

With the exception of these comparatively insignificant corps, the military telegraphs were entirely in the hands of civil volunteers. The zealous, conscientious, and skilful manner in which they carried out their difficult task speaks highly for the patriotic spirit of the corps, and the enormous activity which it developed during the war is the best proof of its usefulness and devotion. From the commencement of the war on the 25th April, 1861, until the 15th of November following, 1,831 kilometres of field lines and 106 military telegraph stations were erected, and the director-general, Anson Stager, was able to report to the Minister of War that the field telegraph was in a condition to follow the army on the march at the rate of 13 to 19 kilometres per day, and it formed the sole means of communication between the commanders of the different divisions and the ministry. Until October, 1861, the military operations in the extensive territory between Fort Munroe and New Mexico were conducted without unanimity of action and without a central command. This want of centralisation existed not only in the army but also in the field telegraph corps itself, but when General McClellan received the chief command of the army all this was altered. Anson Stager was made director-general of telegraphs with the rank of captain, in November, 1861, and was promoted to the rank of colonel in February, 1862. Thirteen inspectors of the telegraph corps received the ranks of captain and major, and in the later years of the war some few more inspectors became officers, otherwise the *personnel* retained its civil character and organisation, though working in common with the soldiers and sharing in all their hardships and dangers.

The organisation of the Confederate Telegraph Corps is also treated of in Plum's book. The telegraph was recognised by the South as an important factor in the development of military operations; it did not, however, attain such proportions as in the Northern army. There was no organised military field telegraph corps, with the exception of a few local companies, as, for instance, at the siege of Charleston, under General Beauregard. With such few exceptions, the field telegraph of the Confederates was recruited from civil volunteers the same as in the North.

Eckert was appointed telegraph major of the Northern army and second in command to Colonel Stager. With Eckert, himself an experienced telegraph director, rested the special duty of maintaining a constant telegraphic connection between the different divisional headquarters.

Plum says: "It was worth regiments of soldiers to *know* that an attack on any point of McClellan's lines, many miles long, would be reported in time to be promptly met. It was worth 'a mint of money' to the people of the North to receive daily detailed reports of operations about Yorktown, but it was somewhat dangerous business for the telegrapher at the front."

When Captain F. R. Buchholtz of the Prussian army published in 1877 his valuable work on "War Telegraphy," he particularly pointed out the need of extending the field

* Translated by Lieutenant Bagnold, R.E., from the German of R. von Fischer Treuenfeld, in the *Elektrotechnischen Zeitschrift*.

telegraphs beyond the divisional quarters—the limit now assigned to it in Germany—so that it might be used in outpost service during reconnoitring and in battles. The experience of the American military telegraphs seems to have been unknown to European officers, for Buchholtz said in his work that only one case was on record in which telegraphy was used in actual battle, and that was at Fredericksburg. Plum's book, however, describes many cases * where telegraph stations were established on the battlefield and during reconnoitring, and these facts even now, after a lapse of 20 years, still possess great importance. But we also learn that military telegraphy requires men of the highest practical training, and that no success can be expected from officers and men who have not made this branch their profession, but who merely possess a general acquaintance with the subject. Results can be obtained by thorough training that mediocrity could never rival, and this is true of telegraphy to an extent which to non-professionals may seem marvellous.†

The telegraph lines were often exposed to destruction by the enemy, and particularly by "franc tireurs." Line-men had almost daily to ride along the line to repair any immediate damage. Many of these men lost their lives, but as soon as one fell another took his place, and the Government in whose service they lost their lives has taken no notice of their fate, because they were not recognised government officials. None of the wives or children of these men have ever received the slightest compensation—no memorial reminds us of these heroes, no salute has ever been fired over their graves.

Although the military telegraph proved of considerable efficiency at the commencement of the war, many officers, nevertheless, had no confidence in its well-earned reputation, and many a bloody and obstinate battle might have been avoided or shortened if the necessary telegraphic connection had been on the spot. In proof of this, Plum quotes especially the obstinate fighting at Fort Donelson under General Grant.

The Americans often tapped the enemies' lines, not only for the purpose of intercepting telegrams, but to send false orders and produce confusion. The Confederate Captain Morgan and Telegraphist Ellsworth as early as 1862 gave their special attention to tapping the Federal lines, and the author gives most interesting accounts of such episodes. The Federals soon sent spies also to intercept the telegrams of the South.

It is remarkable that the Americans in spite of these experiences did not abstain from advancing their stations into the enemy's lines. The attempts to tamper with the wires were, however, quickly discovered and rendered harmless by using cipher telegrams. The knowledge of cipher telegraphy soon attained great perfection, and Plum describes very minutely the systems used, which might prove of considerable practical value to European telegraphists. Important telegrams, especially to the front, were always telegraphed in cipher. The cipher was often changed, and the key was intrusted to only a few telegraphists, and was not even known to the staff officers. A cipher telegraphist was attached to each of the headquarters, and the ability of these men in transcribing became so great that there was practically no delay in the transmission of the messages.

Although cryptography makes the interception of telegrams useless so far as gaining information is concerned, a source of security exists in the fact of the telegraphists reading by sound. Proficiency in reading by sound may indeed be regarded as an indispensable accomplishment at the front. Although the sounder has the disadvantage, in comparison with the recorder, of not registering telegrams, yet it has the great advantage of cultivating the operator's ear so as to enable him to receive messages in spite of defective insulation and feeble currents. A telegraphist accustomed to the sounder can receive telegrams from defective lines when it would be impossible for one only used to the recorder to receive with that instrument under similar conditions. This is important in outpost telegraphy, as the ear attains a certain power of recognising a strange operator by the pace and quality of his signalling, and this is a further reason why the *personnel* of outpost telegraphs should consist of the most skilful men only.

The astonishing perfection with which American telegraphists read by sound is explained by the circumstance that the sounder had been adopted in America since 1846, to the nearly entire exclusion of any other form of telegraph apparatus. *

Telegraphists frequently accompanied troops when reconnoitring, the reconnaissances being made on locomotives, so that the sphere of action of the telegraph was extended even beyond the outposts. This was not an exception, but a systematic practice, and General Haupt reports to the committee appointed under General Pope to inquire into the campaign in Virginia:

"I cannot speak in too strong terms of commendation of the zeal and courage of the railway *employés* and of the telegraph operators, who, with a full understanding that the service was very hazardous, volunteered for the occasion." The operators "proceeded with instructions to conceal themselves in the bushes, send out scouts, make connection with their wire, and report all that they saw or heard. Nearly all the information given to the department (War) at Washington for the remaining days of the fight was received through this channel."

Such telegraphs were often erected and taken down under fire and were often abandoned with loss of men and material.† The building parties were exposed to the same dangers as the office operators. The former were also composed, with few exceptions, of civilians who received their orders from the divisional inspectors. Plum's work

* These cases are too numerous to relate, it will suffice to mention the most remarkable. On June 27th, 1862, Operator Jesse Bunnell, erected a field station 300 feet in the rear of General Porter's army. During the engagement at Gaine's Mills this station was in uninterrupted operation and in communication with the reserves of McClellan's headquarters. Bunnell was for hours exposed to the enemies' fire with no other shelter than a tree. The tumult and confusion of the fight, and the constant distraction caused by the arrival of numerous telegrams greatly increased the difficulty of receiving by ear, and Bunnell's extraordinary ability alone enabled him to carry out the service. It was also necessary to make two or three copies of the telegrams and forward them by separate orderlies, as many of them were killed. General Porter was fighting with 35,000 men against overpowering forces, so that the telegraph was constantly required for the calling up of reserves. Without the aid of the telegraph General McClellan could not possibly have gained the victory, which was only obtained at the cost of 9,000 men of his army and almost as many on the other side.

Plum closes his description of the invaluable services rendered by Bunnell during the battle of Gaine's Mills in these words: "What confidence to repose in a beardless operator, unhonoured to this day!"

† The following case may also serve as an example:—Telegraph-Superintendent Fuller had received orders to erect a line from Lebanon to Columbia for communication with General Boyle's division. When Fuller reached Columbia with the telegraph wires the office apparatus was missing. General Boyle, who had important dispatches to send, was so enraged about the lost apparatus that he threatened to shoot Fuller. The latter, however, quietly took the General's messages and telegraphed them (in default of a key) by touching the ends of the cut wire, and received all answers correctly by applying the wires on and under his tongue. General Boyle, who was highly astounded at Fuller's proceedings, and perhaps a little ashamed, said, "You are too useful to be shot just yet."

Telegrams were often received by means of the tongue, when the apparatus had been lost or destroyed in battles. This was done by the author in the neighbourhood of Clarksville.

* Let us show the importance of cryptography by relating one of the numerous cases which occurred. On a line that connected Grant's headquarters with Fort Monroe at the time of the advance against Richmond, Operator Charles Gaston, of General Lee's Corps, was sent out, accompanied by a few soldiers disguised as woodcutters, to connect his sounder with the enemy's line in the neighbourhood of Sassey Court House in a wood. For this purpose an insulator was prepared that would hold both ends of the wire when cut, without visibly differing from the other insulators; from this two fine silk covered wires were led under the bark of the post to a short distance into the wood and covered with grass. The disguised soldiers kept watch whilst the operator was in direct communication with City Point and the enemy's War-office. Gaston, without telegraphing himself, remained for six weeks thus connected with General Grant's lines. This incident shows what an expert and intelligent telegraphist can do in time of war; but it likewise proves that the interception of messages is quite harmless if sent in cipher. Although Gaston received patiently for six weeks all the enemy's telegrams, only one was comprehensible to him, for only this one was not transmitted in cipher This telegram, intercepted on September 12th, 1864, was the cause of the capture from the Federals of a transport of 2,486 oxen, 200 mules, 300 soldiers, 40 telegraph workmen, and 32 laden transport waggons.

† For instance, when reconnoitring the town of Farrington, led by Operator Parsons and accompanied by a cavalry company under Captain Smith, the telegraph line of 6·5 kilomètres was erected by the cavalry. The troops were attacked and a great number of men were taken prisoners. Parsons telegraphed under fire whilst he was slowly retreating with the rest of the troops, thereby keeping up telegraphic communication with headquarters.

contains detailed descriptions of the difficulties under which the telegraph followed the marching armies. The author does not omit to mention the zeal and patriotism of these officials, especially of William Fuller, subsequently made a captain, who played an important part during the war.

The number of telegraphists who were captured in the exercise of their duties will be regarded as a proof of the extensive part which the telegraph played in the tactical operations during the war. It also indicates that telegraphists were not only the last men in a retreat, but were also frequently among the foremost in a reconnoitring expedition. Much valuable experience is to be gained from these facts when considering the organisation of field telegraphy for European armies where outpost telegraphy has never yet been even approximately brought to the state of perfection, which it had attained in America 20 years ago.

Colonel Anson Stager reported to General Meigs, on June 30th, 1863:—

"Follow the army where you will, there you will find the telegraph exercising its vigilance and its protection over the surrounding camps. At the foremost picket-posts, in the rifle pits, and in the advanced parallels, at any hour of the day or of the night, you can listen to the mysterious, yet intellectual, click of the telegraph instruments, amidst the strife of battle and the whistling of bullets its swift silent messengers pass unseen and unharmed."

Plum urges the advisability of the telegraphic conveyance of orders on the battlefield, relying for its utility and safety upon his own experience and upon a number of historical facts. We must, however, point out to the author one mistake requiring correction. He says, "Captain Buchholtz, another German author, doubts the use of the telegraph on any battlefield, but the American instances are very numerous." Captain Buchholtz, however, has won more fame in Europe than any other man by his attempts to extend telegraphy to the outposts. He is the constructor of the best outpost apparatus and has struggled hard to give it a greater sphere of action in Germany. His success at home was only limited, but other countries have adopted his ideas and use his apparatus in their armies. For instance, Holland, Russia, Spain, Belgium, &c.

The value which the Americans laid on the maintenance of their telegraphic communications is shown by the fact that General Hooker detached one regiment exclusively* for patrolling the line between "United States Ford" and Falmouth. The soldiers had orders to shoot any one attempting to damage the telegraph.

The telegraphists and workmen of the Military Telegraph Corps were exempt from military duties. Many of them were, nevertheless, forced to enter the army and were frequently ordered back as soldiers for the military telegraph service. The United States Government demanded from every telegraphist an oath of fidelity of service.

Notwithstanding their important and confidential position as cipherists, which brought them into close connection with the commanding officers, they held no military rank. This fact gave rise to much unpleasantness, such as denying the operators a place at the officers' mess, ranking them with orderlies, &c. Under these conditions the unfriendly feeling could not fail to assume at times such proportions that the success of the armies became endangered. Well-meant attempts to gain for the corps a military organisation were repeatedly made by the men and their chiefs. The War-office received these proposals, acknowledged the value and enthusiasm of the corps and its anomalous position, especially of those working at the front, but made no alterations. Mr. Stanton, Secretary of State, considered that the military telegraph acted more independently and effectively under the exclusive command of its civil officials than it could do if officers and men had military rank, which would place them invariably under the command of the officers of the army. Stanton was of opinion that this should be especially avoided. This decision of the War-office was the cause of the commencement of the first complaints of the military telegraph corps, which up to the present day has received no proper redress. If President Lincoln and Secretary Stanton had lived, the services of the military telegraphists would have been acknowledged and rewarded at the close of the campaign. When, however, the leading statesmen changed, the sacrifices and claims of the military telegraphists were completely forgotten, and this civil corps, organised in the hour of need, without the warrant of Congress, had not even the right to demand a recognition.

(To be continued.)

* On February 17th, 1864, S. N. Palmer, General of Brigade, reported as follows to Major-General B. F. Butler, then commanding Virginia and North Carolina:—"General . . . . . Extract.—At no time, I suspect, during the present war has the utility of the Military Telegraph and the Signal Corps been more fully demonstrated than during the late attack. The attack had scarcely commenced at the outposts when the telegraph had not only informed me of all that was going on in front, but the whole line of posts to Morehead was put upon its guard, and during the day, when the enemy were immediately around the town, the Signal Corps kept us advised of the smallest movements of the enemy at any point of the line. I cannot think too highly of these two corps."

THE ELECTRIC LIGHT ON SHIPS.

A CONSIDERABLE amount of business is being quietly effected, as our readers are aware, in introducing the electric light on board many of our largest and best known vessels. We notice a description, in the *Electrical World* of New York, of the illumination of the steamer *Pilgrim*, of the Fall River Line, by means of Edison's incandescence lamps, and this we think of sufficient interest to bring before our English engineers.

The *Pilgrim* was built by John Roach & Son, Chester, Pa., and she is considered the finest craft of her class afloat. Her greatest length is 390 ft., her extreme width 87 ft. 6 in., and her hold is 18½ ft. deep. Her registered tonnage is 3,500 tons. The hull is built of iron, on the longitudinal bracket system; that is to say, the *Pilgrim* is a ship within a ship, and has 103 water-tight compartments. She is expected to make 20 miles an hour. The paddle wheels are 41 ft. in diameter, and the walking beams weigh 33 tons. Each one of the 250 state-rooms contains black walnut furniture, electric light and call-bell, and a plate-glass mirror. She is said to be able to carry a thousand passengers comfortably.

The *Pilgrim* is lighted solely by electricity. The current for the lights is furnished by three Edison dynamo-electric machines, two of the "K" type and one of the "L" or next smaller size. These machines each have the same electromotive force, and are connected with the leading conductors in parallel circuit. Their standard of electromotive force is 110 volts, but they are allowed to develop only 108 volts, in order to adapt the current to the resistance of the lamps. These machines are driven by two Armington and Sims high-speed engines, and a special boiler of 150 horse-power furnishes the steam at 80 lbs. pressure; and in case of necessity connections may be made with the donkey boilers or the main boilers. These engines are both bolted directly to the dynamos, the former serving to actuate one of the K dynamos and the latter operating the other K and the L dynamo. The field of each dynamo is wound in derivation, as in all the Edison machines, in order that the amount of current supplied the lighting circuit may regulate itself to the number of lights in use at any given time. But as this method is not of itself sufficient to make the regulation absolutely perfect, the lighting company has resorted to the device of Mr. Edison, which causes the resistance of the derived circuit to diminish so as to make a stronger magnetic field when more lights are used and the current requires to be stronger, or to increase and weaken it when the number of lights used is less. The governor, by means of which this is accomplished automatically, is one of the most ingenious features of the installation. The box which holds the resistance coils, which are switched into the field-circuit as occasion requires, supports a glass case, which contains the governing apparatus. A large "relay" magnet in this case is included in a derivation of the external circuit, and is balanced by a spring. The armature carries two contact points, one on each side. Two large U electro-magnets are near this relay, their armatures attached to a frame rocking shaft placed midway between them. This shaft carries an arm which is pro longed downward, like a pendulum, and corresponding to the ball of the pendulum is a flat strip of sheet copper bent to form a rubbing contact which can pass over contact strips separated by insulation. These strips look like a portion of the Gramme commutator inverted; that is to say, a commu-

tator in which the brush rubs on the inside of the circumference. The resistance coils loop from one to the next of these strips, precisely as the sections of a Gramme armature. The field-magnet circuit goes to one end of this "commutator," passes through the contact piece of the pendulum, and from this back again to the machine. Accordingly, when the rubbing contact touches the first strip none of the resistance coils are included in the field circuit, while if it touches the last strip, all the resistance is introduced in the field circuit. When the current in the external circuit is normal the armature of the relay is held balanced against its retractile spring in such a manner that neither of its contacts touch the connections on either side. If the current weakens the spring pulls the armature back and a contact is formed which transmits the current to one of the magnets of the regulator, and causes the frame to rock and the rubbing contact to move so that some sections of the resistance in the field circuit are cut out. As soon as enough resistance is cut out and the current in the external circuit increased to its normal value, the relay cuts out this magnet and the rubbing contact remains in this position. If the current becomes too strong, the armature is attracted sufficiently to close the circuit through the other magnet. This causes the rubbing contact to move backward and resistance is introduced into the field circuit. An incandescent lamp is included in the circuit of each of the two electro-magnets, and its light serves as an indicator of the condition of the circuit, since one glows while the current is below and the other while above the standard value.

To the electrical engineer the most interesting part of the whole plant is, without doubt, the manner in which the conductors are disposed throughout the vessel and the method of arranging and connecting the lamps with respect to them. The steamer is divided into four sections with reference to the distributing current. It may be said that the distribution proceeds from the centre of the vessel, or rather the centre of illumination. The plant is located in the fore part of the hold, but the current is conveyed by main conductors on each side, enclosed in iron tubes, like the conductors in Edison's street system, to about the centre of the vessel, where they go upward, passing through every deck. On each deck is a safety box, like those at street corners in the street system, and a conductor goes from this to the front of the steamer, supplying the lights on its way, and a similar conductor goes to the rear. The arrangement is the same for each deck, which has four sections—two on each side—and the safety box provides that one section may be cut out without interfering with the others.

In the engine-room four switches are placed within easy reach of the engineer, which gives him control of all the lights on that deck. It is estimated that the total length of conductors and wires used throughout the boat is not less than ten miles.

The lamps are of 16 and 10 candle-power, and have an average resistance of 137 and 250 ohms respectively. All are connected in multiple or parallel circuit, and it is, therefore, because the 16-candle lamps have a lower resistance and receive proportionally more current than the others that they give more light. The lamps are disposed as follows :—

	16-candle-power lamps.	10-candle-power lamps.
Grand saloon and gallery	199	250
Main deck	131	138
Dining-room and after-cabin	32	110
Forward cabin	15	37
	377	535

16-candle-power A lamps	377
10-candle-power A lamps	535
Total number of lamps	912

Each lamp is provided with a safety cut-out in case of accident, except those in the chandeliers, which have a cut-out only for each group.

The installation is probably the largest and most complete which has yet been made on board of any steamship, and the scrupulous attention to details which it reveals reflects the highest credit on the Edison Company for Isolated Lighting, that had the contract for the work. The installation is highly successful when judged merely by its effects.

NOTES.

Electric Lighting.—On Friday evening of last week Mr. Shaw-Lefevre, M.P., the First Commissioner of Works, and a party of friends formally inspected, under the guidance of Mr. R. E. Crompton, the arrangements which have now been completed by the Swan United Electric Light Company, through their contractors, Messrs. Crompton & Co., for the lighting of the Royal Courts of Justice by the electric light. The central hall on the occasion was brilliantly illuminated by six Crompton arc lamps, each of 4,000 candle-power, while the courts, to the number of 20, and corridors were lighted by Swan incandescent lamps. In all 625 of these lamps are distributed throughout the building, from 22 to 24 being located in each court. The conducting wires laid extend to 20,000 yards. The generating machinery is temporarily situated in an iron building to the west of the main building; but it is proposed ultimately, should the experiment prove successful, to transport it to the crypt beneath the central hall. The engine-power provided is sufficient to drive four hundred of the incandescent lamps, besides the arc lights, and to provide for the lighting of the remainder, 80 two horse-power Faure-Sellon-Volckmar accumulators have been placed in connection in the vaults, which, when fully charged, are deemed sufficient to light six of the courts without any aid from the generators. For charging the accumulators during daylight, and for working the four hundred lamps, six dynamo-machines of the Crompton-Burgin type are used, this division of the generating machinery being intended to obviate any risk of a breakdown. At the conclusion of the inspection, Mr. Shaw-Lefevre expressed himself as perfectly satisfied with the arrangements.

The *Evening Post* of New York says :—"The latest 'bulletin' issued by the Edison Electric Light Company states that the number of houses now lighted from their down-town station in Pearl Street is 429, in which are 10,268 lamps. The six dynamos in the station are capable of running 7,200 lamps at one time, but in an office building it is not likely that more than half the number will be burning at the same time, and in private houses the average of lights needed will not exceed five or six out of a possible 25. Nearly double the number of lamps now in the down-town district can therefore be connected with the station without over-taxing the current-producing power of the dynamos. The average monthly increase in the number of lamps is about 500. Major Eaton, president of the company, says it is proposed to extend the field of the down-town station by running wires along the east side of Broadway, from Fulton Street to Wall Street, thus taking in a large number of valuable office buildings. The machinery at the station is now working with satisfactory smoothness. As to the cost of the light, Major Eaton believed many persons had complained that the new light cost them more than gas, because they wanted to get cheaper rates for electricity than they had been paying for gas. Moreover, from October till January no charges for electricity were made, so that every one got to be extravagant in using the light. The present charge is estimated to be at a rate equivalent to that of gas at $2·25 a thousand cubic feet. The Edison Company is, according to Major Eaton, entirely satisfied with the present position of affairs, and a dividend at the end of the year is mentioned, the company now making money and expecting to make much more when the whole plant is in use. Within the last three months Mr. Edison has made two important inventions relating to electric lighting. The first is a new arrangement of the magnets of his dynamo, by which at the same cost and with no more weight the result is double what it formerly was, provided, of course, that the steam-power is doubled. Thus a 28 light dynamo, if rearranged by this new method, gives current for 40 lights by doubling the steam-power. As the expense of the dynamo is large, the possibility of doing the same work with half their number improves the situation considerably, and in a number of stations to be established within a few months in other cities the new dynamos are to be used entirely. Mr. Edison's second improvement concerns the method of distributing the current through the street mains. By the use of three wires instead of two he is enabled to use lighter wire and save about half the

expense of copper. If he had known two years ago what he knows now about city stations he could have saved, he says, 60 per cent. of the large cost of the Pearl Street station. The Edison Company announces that before January, 1884, there will be 20 different Edison stations in as many cities and towns well under way, or in operation.

The principal rooms of the Liverpool Junior Conservative Club, which was formally opened on Tuesday of last week by Earl Lathom, have been fitted with the electric light. Compound gas and electric fittings have been supplied by Messrs. Bennett Brothers, and the electrical part of the work has been carried out by the Liverpool Electric Supply Company under the personal superintendence of Messrs. Holmes and Vaudrey, the company's engineers.

An installation of three Pilsen arc lamps and 28 Gatehouse incandescent lamps has just been completed at the Inns of Court Hotel, High Holborn. Two of the arc lamps are used for lighting up the central reading and smoking court and one for the Holborn entrance to the hotel. The incandescent lamps are of 20 candle-power each, and are situated in the dining-room, on the Holborn side of the hotel. The electrical power is obtained from dynamo machines driven by steam power at the central station of the Pilsen-Joel and General Electric Light Company (Limited), in Whetstone Park, Holborn. The effect of the installation in the dining-room is eminently satisfactory, the temperature and atmosphere of the room being found much more agreeable than when gas is used. We believe that this is one of the few instances in which arc lighting has been successfully adopted for reading and writing rooms, the well-known steadiness of the Pilsen lamp rendering it possible. Furthermore we learn that the company is about to exhibit an installation of eight Pilsen arc lamps at the Cork Exhibition, and that the same company has just dispatched an installation of 14 Pilsen arc lamps to Stockholm, which are intended for the lighting of one of the principal portions of that city.

We understand that the Committee of the Reform Club is much pleased with the trial which is now being made with the electric light in the principal rooms of the club, and that it has, through Lord Elphinstone and Mr. Vincent, satisfactorily extended the lighting to the billiard rooms by means of twelve additional Woodhouse and Rawson lamps.

At a meeting of the Commissioners of Sewers on Tuesday Mr. Scott asked the Chairman of the Select Committee on Electricity whether he could give any information as to when the citizens might have the power of using the electric light in their houses, and whether he was aware that this light was already in use on the Viaduct. Mr. Stoneham said the committee had not lost sight of any facts relating to electricity. It hoped to bring up a report in a week or two.

On the occasion of the dinner given by the Speaker at his residence on Saturday evening last, the riverside terrace was illuminated by Edison incandescent lamps. 78, 16-candle and 3, 100-candle-power lamps were employed, the current being furnished by the Edison plant in the House of Commons. The Prince and Princess of Wales, who were amongst the guests, expressed their approval of the lighting arrangements.

The Adelaide Gallery, Strand (Messrs. Gatti's), is being wired for 325 Edison lamps.

In the House of Commons on Wednesday, on the order for the second reading of the Electric Lighting Provisional Orders (No. 4) Bill, Sir H. Vivian asked what provision had been made for the representation of the district authorities against this Bill, and whether the Board of Trade intended to refer it to a select or hybrid committee? Mr. J. Holms said the undertakings were of a novel character, and these were the first provisional orders which had come before the House since the passing of the Act. It was proposed to refer them to a hybrid committee so that they might be fully considered; but the Government was very much in the hands of the House, and therefore it was open to any one to make any other suggestion. Mr. Stanhope said, unless the bills were opposed it was not much use referring them to a committee, as the points of detail would not be properly brought out except by opposition. Sir G. Campbell considered that it was very necessary that they should be scrutinised before they were passed. The present Bill sinned against some of the principles which he should have thought the President of the Board of Trade and the Government would have insisted upon—viz., the principle of local economy and local self-government. The Bill was read a second time.

The Late Mr. Spottiswoode.—The remains of the late Mr. William Spottiswoode, President of the Royal Society, who died on the 27th ult., were interred on Thursday, in Westminster Abbey, in the presence of a large and distinguished assemblage of the relatives and friends of the deceased. The coffin, which was of plain oak, with brass mountings, having on the lid a Latin cross and shield-shaped plate, bore the inscription, "William Spottiswoode. Born, January 11, 1825; died, June 27, 1883." The grave is situated at the north-east of the south transept, close to the Poet's Corner, and almost immediately under the shadow of the bust of Dryden, in close contiguity also to the grave of one of Mr. Spottiswoode's ancestors—John Spottiswoode, Archbishop of St. Andrews, who died in 1639. At the annual general meeting of the Society of Arts, held on Wednesday of last week, the following resolution was passed: "That this meeting of the Society of Arts desires to express the deep regret with which it has received the news of the death of Mr. William Spottiswoode, one of its vice-presidents, and its sense of the loss which the Society has sustained by his decease. In him, England loses one of her most remarkable men of science, science itself one of its greatest ornaments, and all who knew him a sincere and valued friend. Besides devoting his own time and thought to the advancement of knowledge, he was ever ready to lend to all engaged in like pursuits the assistance of his experience and his wise counsel. In thus placing on record their own appreciation of his services, the Society desires to express its feelings of sympathy with his widow and his family, and also with the Fellows of the Royal Society, of which he was the honoured and beloved president."

The Chicago Exhibition of Railway Appliances.—The Exhibition of Railway Appliances, which is just commencing at Chicago, bids fair, we read, to be of great importance in electrical matters. The electric light companies are exhibiting their latest improvements in apparatus in actual operation. Regarding this exhibition, the correspondent of the New York *Electrical World* writes as follows:—"When the National Exposition of Railway Appliances was opened to visitors, May 24th, it was in a very imperfect condition, but few of the exhibits being in place. Not until to-day has the exhibition presented an appearance sufficiently interesting to induce the public to attend. Now everything is running smoothly, and the success of the enterprise, financially as well as educationally, will be great. Too much cannot be said of the untiring energy of its promoters in affording the railway interests this opportunity for examination and interchange of ideas. The electrical appliances presented are not as numerous or varied as one would expect to find. The Union Switch and Signal Company makes a fine exhibit of full-size apparatus, as does also the Hall Railway Signal Company, one or two others being shown in model. The Western Electric Company has a fine exhibit of electrical goods, being the only such house represented here. The electric light people are making an excellent showing, nearly all the companies having secured some part of the building to light, and as a number if not all that are here have entered for competition, this part of the exhibition promises to be interesting to electrical readers. The United States Electrical Lighting Company has about 200 arc and 300 incandescent, the Edison Company 250 incandescent, while the Fuller, Brush, and Thomson-Houston companies make up a total of some 500 arc lights, each company showing machines of the various sizes constructed by it. Comparison of the various lights is reserved for another letter, all of them having suffered for power, which, however, is being provided for by additional steam capacity. Probably the most interesting feature of the exhibition, or at least sharing that honour with the old English locomotives, is the electric railway. Through the efforts of Mr. J. McGregor Adams, the Electric Railway Company controlling the Field and Edison patents was induced to give the exhibition an electric railway (the first constructed for business

purposes in this country). Around the gallery, a distance of 1,600 feet, is laid a track of 3-foot gauge, making a rather sharp curve at each end of the building, upon which is run a motor and two cars, seating about fifty passengers. The motor used is a Weston incandescent dynamo, a similar machine serving as the primary by means of a resistance and switch upon the motor; the speed is regulated as desired, the reversing of the direction being accomplished by Mr. Field's invention of reversing gear. Telegrams from Chicago say that the electric railway at the Railway Exposition is now in good running order and carries full loads of passengers. On Saturday, the 16th ult., with one car, 12,000 passengers were carried over the route in eight hours. At no time during this period was there any interruption.

French Electricians.—The fourth meeting of electricians of the society founded by the Comte d'Aros, was held in Paris last month. It was decided by the meeting that a committee should be appointed to frame the articles of a new society for encouraging progress in electric science and corresponding with those in all countries who have made electric questions the chief object of their studies and efforts. The evening's banquet was presided over by M. Loewy, member of the Institute, who had on either side of him M. de Lesseps, M. Faye, M. Robin, Admiral de la Gravière, M. Louis Figuier, and some 30 or 40 others, including 12 members of the Institute, senators, deputies, journalists, and men bearing names well known in different branches of science. At the close of the dinner, between the toasts, M. de Lesseps announced a piece of news of importance. The president of the Suez Canal Company appealed to the members present to compete for a prize for the best means of lighting the canal by electricity. Without entering into details, it is evident, says the *Times*, that such an innovation would very largely increase the capacity of the canal for traffic.

A New Regulator.—M. Tommasi has devised an apparatus intended to render the luminous point in the Jablochkoff candle fixed. The principle on which the inventor works is said to be the following:—It is well known that selenium possesses the curious property of being a better conductor when it is influenced by light than when placed in darkness. On the other hand, the Jablochkoff candle has the disadvantage, by consuming exactly like an ordinary candle, and therefore of lowering progressively its luminous point. M. Tommasi has invented a *selenium regulator*, suitably placed, which receives under certain conditions the light emitted by the Jablochkoff candle, and serves, so to speak, as an automatic elevator of the luminous point, which is regulated by its own light.

An experiment, made on the 2nd of June, showed the sensitiveness of selenium to the electric light, as well as the instantaneousness of its variation of conductivity. A selenium regulator, constructed by MM. Th. and Alb. Dubosq, was placed in a dark chamber in the workshops of the Société de l'Eclairage Electrique. Submitted alternately to the action of the light of a Jablochkoff candle and of darkness, the selenium, traversed by the current from a powerful battery, showed well-marked differences of conductivity. It remains now for M. Tommasi to determine the practical arrangement which will fit this apparatus for commercial use. We understand that the device has been patented, and that M. Tommasi is now occupied in seeking for the best means of obtaining the maximum sensitiveness of the selenium, and that he is endeavouring to apply this body to photometry and telegraphy. For street lighting at all events we do not see much advantage in elevating the luminous point of the Jablochkoff candle.

Protector Attachment for Electrical Conductors.—The engraving shows an improved device for preventing the stretching or breaking of electrical conductors while being introduced into or removed from their enclosing

tubes, and for removing the conductors from their tubes should they become severed. The improvement consists in attaching to the conductor, by a wrapping of wire, a spirally wound wire or clips, a straight wire having a protective coating of gutta-percha or other suitable material, and of sufficient strength to be used in introducing the conductor into or removing it from its tube or casing. This device will render it a simple matter to remove and replace any conductor; it will also greatly facilitate the construction of underground lines. The inventor is Mr. William E. Townsend, Jr., Brooklyn, N.Y.—*Scientific American.*

Accumulator Factory in Milan.—Mr. James Shepherd, of 45, Via Stella, and 3, Piazza Scala, Milan, has resigned his position as general agent of the Italian Edison Company, and has taken out a patent for an accumulator which he is now manufacturing on a somewhat extensive scale. We hope shortly to be able to furnish our readers with a description of same, as both the construction and results already obtained point to a decided success. Mr. Shepherd introduced both the Brush and Edison systems of electric lighting into Italy, and is the originator of the present Italian Edison Syndicate. He also intends to act as agent for the introduction of any kind of machinery or apparatus used in connection with electric lighting or transmission of power, and we have no doubt that his efforts, united to his indomitable perseverance, energy, and practical experience, will meet with success. Mr. Shepherd doubtless feels that electric light installations dependent upon machinery alone for their working are not altogether so reliable as could be desired. This we pointed out last week in our reference to the lighting of the Holborn Viaduct by the Edison system.

The "Baby" Electric Gun.—Colonel Fosbery, during the delivery of his lecture at the Royal United Service Institution last week, created considerable excitement by presenting to his audience a new gun which he had just brought from Liège, and which he designated "the baby electric gun." Its appearance was that of a pretty carbine, but it had no mechanism, and could not go off until connected with a source of electric energy. No sooner, however, was that done than its firing capabilities were demonstrated. The necessary power was supplied from a very small accumulator which Colonel Fosbery had stowed in his vest pocket, and which he stated contained sufficient energy to discharge 2,000 rounds. The opinion was expressed by a number of the experts present that "the baby" must once more revolutionise the manufacture of small arms within a brief period.

The Vienna International Electrical Exhibition Theatre.—This theatre is being fitted up with Swan incandescent lamps by Messrs. Ganz & Co., of Budapest. Fifteen will be in use in the entrance hall and cashier offices, 90 in the foyer, 184 in the spectators' room, 30 for the orchestra, 90 in the wardrobe, and 1,260 on the stage. The current will be generated by a dynamo machine stationed about 350 metres off, and will be supplied by means of a main conductor consisting of soldered insulated copper-bars, 34 mm. thick. An automatic apparatus will regulate the current and also the consumption. Another system of theatrical illumination, to be used alternately with the above, will be effected by Messrs. Piette & Krizik, of Pilsen, by means of arc lamps. The spectators' room will be lighted by three or five of these lamps, the stage by two fixed as footlights, and two or three on every wing.

Business Notice.—Messrs. Hy. Bennett & Co., 131, Hope Street, Glasgow, have been appointed agents in Glasgow for the Electric Carbon, Storage, and Apparatus Manufacturing Company of Scotland (Limited), and will in future transact all the business of this company at the above address.

Americans Returning.—Mr. Theodore Torrey, says an American contemporary, who has for several years been connected with the London and Globe Telephone Company, arrived from Europe on Sunday, the 10th ult. He has resigned his position with the London and Globe, and has connected himself with the Eames Vacuum Brake Company. Mr. H. H. Eldred, general manager of the London and Globe Company, has also resigned, and is expected in America about July 15th. Mr. Eldred is also interested in the

Eames Brake Company. The London and Globe Company *has 400 miles of poles and about 600 miles of wire, and its central office is being connected.* The United Company, however, has harassed its young rival with numerous lawsuits, and now the Americans who projected and carried on the London and Globe have disposed of their interests on satisfactory terms, and the company will hereafter be conducted under English management. Mr. Joseph Sitzenstatter, a Hungarian by birth, who went from this country and did valiant service for the telephone in Belgium, will probably become engineer of the London and Globe Company at a good salary.

Improved Photographic Camera.—Messrs. H. and E. J. Dale, the well-known electrical apparatus manufacturers, have recently turned their attention to photographic apparatus, and have brought out an improvement in the construction of cameras which is well worthy the attention of such of our readers as are interested in photography. The new invention enables a large number of sensitive plates to be carried, and exposed as required, without opening the case or in any way interfering with the plates, thus entirely avoiding any risk of fogging through changing plates in the field. The action of changing the plate is entirely automatic, and being effected by "gravity" there are no springs to get out of order.

The United Telephone Company *v.* Andrews.—In the Chancery Division of the High Court of Justice on Friday of last week the plaintiff company sought an injunction to restrain the infringement of two of their patents, and also asked for the surrender of all articles manufactured by the defendant, in infringement, an inquiry as to damages sustained, and for costs. The defendant not appearing, his lordship made an order in the terms of the notice of motion.

Electric Lighting Provisional Orders.—In the House of Commons on Friday of last week Mr. J. Holms brought in a Bill for confirming certain Provisional Orders made by the Board of Trade under the Electric Lighting Act, 1882, relating to Chiswick and St. George the Martyr, Southwark, and a similar Bill relating to Dundee.

New Atlantic Cables.—The *New York Times* states that Alderman Hadley, of London, has successfully accomplished his errand in connection with the American and British Continental Cable Company. The projects of this company include the laying of a cable from near Glasgow, *viâ* Belleisle, to Canada; and a second from Penzance, *viâ* Sable Island and Long Island, to New York. These are to be laid immediately at a cost of £650,000 each. Ultimately the cables of this company are to extend around the world.

Hospitals and the Telephone.—Sir Sydney H. Waterlow, the treasurer of St. Bartholomew's Hospital, has nearly completed arrangements with the United Telephone Company (Limited), with a view of placing the principal hospitals in London in direct telephonic communication with the surgeons and physicians belonging to those institutions. The scheme proposed is that the various hospitals should be made the centres of communication; that the telephone company should connect the large hospitals with the nearest telephonic exchange free of any charge, the company being remunerated by the payments to be made by the surgeons and physicians for connecting their private residences with the exchange. The experiment has been commenced by placing St. Bartholomew's Hospital in communication with the Regent Street Exchange. Should the scheme prove successful, the telephone company has undertaken to provide a special system of wires for the purpose, and the necessary clerks to work them by night as well as by day.

Sixpenny Telegrams.—In a Treasury minute, dated June 14th, which has been issued as a parliamentary paper, on the question of the reduction of the minimum price of telegrams to sixpence, the Chancellor of the Exchequer recommends that general authority be given to the Postmaster-General for the necessary preliminary expenses, which are expected to amount to £500,000; and he is further prepared for an expenditure of £200,000 of this sum in the current financial year. The reduction will come into operation on the 1st of October, 1884. Mr. Childers leaves for future inquiry the question whether the first or second of the tariffs suggested by Mr. Fawcett should be adopted; but he pronounces against the third as involving too heavy a charge on the public. These tariffs are as follows:—1. Free addresses to be abolished, and a halfpenny charged for each word, including the address; minimum charge, sixpence. Estimated loss of income in first year of adoption, £170,000. 2. Address of receiver to be free, but that of sender to be charged for; sixpence to be charged for the first five words, and twopence additional for each subsequent five words. Estimated loss of income in first year, £270,000. 3. Scale as in 2, but both addresses to be free. The loss would be larger than in 2, and for preliminary expense would be increased from £500,000 to £625,000. Mr. Alderman Lawrence gave notice in the House of Commons on Monday evening that on the occasion of the introduction of the scheme of sixpenny telegrams he would move that it was not expedient, in order to reduce the minimum price to sixpence to increase the present tariff for twenty words and upwards, as would be the case under the proposed scheme. He would also move that it was not expedient to charge for the number of words in addresses either of the receiver or sender. As an alternative scheme he would move the following: that addresses be considered of the value of 2d.; that eight words at a halfpenny each would be 4d., and that 2d. added to 4d. will be sixpence. His proposition was, 8 words 6d, 12 words 8d., 16 words 10d., 20 words 1s., 24 words 1s. 2d., 28 words 1s. 4d. and 30 words 1s. 6d.

Rival Companies.—A few days ago the Electric News Telegraph Company issued a card to stockbrokers, asking them to combine efficiency with economy, and save £20 per annum by having its service of Stock Exchange quotations, the cost of which would be reduced from the 1st inst. to £20 per annum, "instead of the Exchange Telegraph Company's costing £40," and stating that its service would be supplied "three months free to parties giving up the other company's instruments." The Exchange Telegraph Company has now published a notice to its subscribers in reference to the matter, assuring them that it is quite impossible to permanently supply an efficient service at the reduced rate of the Electric News Telegraph Company, and asserting that "this action on the part of the Electric News Company is an attempt to take away our subscribers, and is in consequence of our refusal to accept an arrangement proposed by that company and involving an increase of rates." We do not see why the efficient service at a reduced rate is impossible, but it is grievous to see two companies resort to these measures instead of competing on fair terms.

The "St. George" Telephone.—On Tuesday afternoon we were present at the White House, Telegraph Street, Moorgate Street, to witness demonstrations of the capabilities of the St. George Telephone, which is named after the inventor, and which is the property of the St. George Telephone Company (Limited). The special advantages of this telephone are said to be its loudness and distinctness. The company urges that the public can now purchase outright an instrument which combines simplicity with efficiency, and does not get out of order. We were quite satisfied with the speaking of this telephone, but we think it a mistake on the part of the company's officials to lead the newspaper press to say, "it was stated that as four or five receivers were employed the distance represented was upward of 20 miles," although the distance apart of the two stations was but a few hundred yards. We have over and over again shown the absurdity of comparing an artificial resistance with an actual line. The company will supply two transmitters and two receivers for ten guineas, and the purchaser, it is said, will be independent of patent rights, and thus allowed to fix the instruments himself in any part of his premises. The St. George telephone has been tested along the whole course of the ordinary line-wire between London and Dover, and in all these trials we are informed the results have been good. No adjustment of the telephone is required, and it is not affected by any loud and sudden noise in the room. The company intends going in largely for exchange systems, and we hope shortly to be able to give full information concerning Mr. St. George's instruments. We may mention that the battery employed by Mr. St. George for his telephonic system is a special form of Fuller's bichromate.

Cable Repair.—The Western and Brazilian Telegraph Company, Limited, notifies the repair of its Maldonado-Monte Video cable, thus restoring telegraphic communication throughout the whole of its system.

NEW COMPANIES REGISTERED.

"St. George" Telephone Company (Limited).—Capital £300,000, in £5 shares. Objects: The business of a telephone and telegraph company in all branches. Signatories (with 50 shares each): J. Crisp Fuller (telegraph engineer), Stratford; W. G. Chester Claverley, Surbiton; R. S. Tomlin, Cheyne Walk, Chelsea; A. T. Bruce, Lyme Regis; H. Smiles, 45, Bedford Square; R. S. Berkie, Junior Carlton Club; D. A. Onslow, J.P., 14, Waverley Place, St. John's Wood. Directing qualification: £250 of nominal capital; remuneration £200 per annum in respect of each director, with an additional £100 per annum for the chairman. Registered 28th ult., by G. Davis, Son & Co., 80, Coleman Street, E.C.

Economic Electric Company (Limited).—Objects: To carry on the business of an electric light and power company in all branches, and to purchase the debts, debentures, and shares of the Duplex Electric Light, Power, and Storage Company (Limited), and to pay for the same in debentures of this company of the same nominal value. The company is registered without nominal capital, every member undertaking to contribute any sum not exceeding £1 in the event of winding-up. Signatories: *Stephen H. Emmens (electrical engineer), 8, Argyll Street; G. C. V. Holmes, C.E., 13, Sussex Villas; J. Mallard, 19, Portman Road, West Kensington; F. T. Rushton, 2, Lancaster Place, Strand; E. B. Illidge, 45, Great Marlborough Street; F. J. Mitchell, Weybridge; S. Boome, 45, Great Marlborough Street. The following are appointed directors, viz.:—Dr. John Baker Boley, Dr. S. H. Emmens, F. E. Brewer, Colonel Percival Ashley Brown, Dr. F. J. Lilley, John Munro, Charles Penrnddocke, and Captain Peter Macfarlane Syme. Registered office, 9, Soho Square. Registered 29th ult., by Harry Beaumont, 3, Charles Street, Soho Square.

Electric Construction and Maintenance Company (Limited).—Capital £100,000, in £10 shares. Objects: To produce and supply electricity, and to manufacture electrical machinery and apparatus. Signatories (with one share each), H. Tipple, 14, Spelshurst Road, South Hackney; F. W. Hull, 145A, Drummond Road, S.E.; C. J. Vollhardt, 29, Villiers Street; R. S. Ward, 24, Grafton Street, Mile End; E. H. Carter, Birmingham; E. Pritchard, C.E., Birmingham; Joseph Smith, Wednesbury. Directing qualification: Shares, stock, or debentures of the nominal value of £250. Registered by Walter Webb & Co., 23, Queen Victoria Street.

South Kensington Mutual Electric Lighting and Supply Company (Limited).—The registered offices of this company are situate at the Royal Albert Hall, South Kensington.

* Those signatories whose names are preceded by an asterisk are also directors.

CITY NOTES, REPORTS, MEETINGS, &c.

The London and Globe Telephone and Maintenance Company (Limited).

THE second ordinary general meeting was held at St. Michael's Hall, George Yard, Lombard Street, E.C., on Wednesday, Mr. Stewart Pixley, the Chairman of the Company, presiding.

The Secretary (Mr. J. Ford) read the notice convening the meeting, and

The report of the directors was taken as read. It said:—The organisation of telephone exchanges in this country being a comparatively new business, great caution has been necessary in taking each step, so as to insure as far as possible the success of the undertaking. This in itself has occupied much time and caused delay in commencing operations. The company has also, from its incorporation early in 1882, both before and after the present directors took office, met with strenuous and uncompromising opposition from a rival company. The procuring of the licence from the Postmaster-General, without which no public telephone business could be carried on, was a further source of delay, some months having elapsed from the time when the present directors took office before the details of the licence were completed. As soon as the licence was completed, active operations were commenced for the purpose of erecting Metropolitan exchanges, and in this respect the most satisfactory results have been obtained. Suitable premises for the erection of exchanges and for the work necessary to be undertaken have been leased, and such progress has been made that already some hundred miles of wire have been run and connections made, and the chief central exchange will shortly be in full working order, and ready to receive two thousand subscribers. The directors feel sanguine that the small charge of £10 10s., and the fact that the subscribers will have an efficient day and night service, a convenience hitherto unknown in this country, will attract a number of subscribers far exceeding that of their rivals. The directors think it right that the shareholders should be made acquainted with the nature of the opposition from the United Telephone Company with which they have had to deal, at almost every step taken for the establishment of this company's business. The United Company have apparently acted as if under the impression that they were entitled to the monopoly of telephone communication in the United Kingdom, and they have waged a war not only for supremacy but of extermination. Determined efforts by public advertisement and otherwise were made by the United Company to prevent the subscription of the capital of this company, and failing in this, similar opposition has been continued at every stage of the proceedings. As soon as the licence from the Post-office had been obtained, the United Company directed their efforts to preventing this company from establishing its exchanges in the metropolis—wires have been interfered with—dummy wires run for blocking purposes—and every possible action taken to harass and annoy the officers of this company, some of whom have recently been subjected even to a criminal prosecution at the instance of the United Company. Within the last few weeks three actions have been instituted in the Chancery Courts by the United Company, obviously for the purpose of preventing this company from doing business. Notwithstanding this vexatious interference, steady progress has been and still continues to be made, and your directors anticipate with confidence that the company's chief exchange will shortly be in active operation. Whether the United Company are justified or not by their service and high rate of subscription or by any other consideration, in endeavouring to obtain a monopoly of the telephone business, your directors are contented to leave to the judgment of the public, who have had some experience of the United Telephone Company's method of doing business.

The Chairman said: Although the present meeting is in fact the second ordinary general meeting of the company, it is, as regards the present shareholders, their first meeting. The company was registered in January, 1882, and the first or statutory general meeting was held in due course, thus this meeting becomes a second ordinary meeting. The capital of the company was not subscribed until the end of August, 1882, and the shareholders will doubtless remember the strenuous efforts made by the United Company, by advertisements, to discourage intending subscribers. They were not successful, as you know, and an allotment was made towards the end of August last. This period, being in the height of the holiday season, was not favourable to immediate action. Moreover, the Postmaster-General's licence had not been obtained, because it was known that he would only grant his licence to a responsible corporation with a sufficient capital. Mr. Eldred's experiences as a telephone constructor for carrying on the operations of the company, in regard to establishing exchanges in the metropolis and developing the business generally, were very valuable. In this connection, it may be mentioned that Mr. Eldred had had a vast experience in America in telephone business, most of the telephone exchanges in different parts of the United States having been planned and carried out by him. I visited America in the autumn of last year, and whilst there took considerable pains to inquire into the nature and character of the telephone business as carried on in the United States, and it will be sufficient for this purpose to say that the result of my inquiries convinced me that telephone business in this country was still in its infancy. As soon as Mr. Eldred returned active operations were commenced with a view to establishing the company's telephone business, although at this time the Postmaster-General's licence had not actually been granted, but it was understood the company would secure it. The licence was in fact not signed until the 31st of January last; but between the date of Mr. Eldred's return and the date of the licence satisfactory progress had been made in arranging routes and obtaining wayleaves for the metropolitan exchanges of the company. The shareholders probably have but little conception of the difficulty encountered in running overhead wires in a large city like London. Telegraph wires of different descriptions have been run from time to time either by public companies or private individuals, so that it requires the greatest skill and management to secure routes for new wires. The public, too, have been uneasy with regard to these wires, as it is of course necessary to erect fixtures on houses to carry the wires. This uneasiness has made the task of obtaining wayleaves and the right to fix poles one of additional difficulty. These difficulties have, it is believed, been in great part overcome, but not without very considerable delay and a not inconsiderable expense, a large staff having to be organised and employed to secure to the company the rights and privileges they required. The result is that at the present moment the company are the owners of rights or wayleaves numbering considerably over 1,000; they have erected over 400 poles and run several hundred miles of wires. Offices have been secured for the exchanges, and the connecting up of subscribers with such exchanges have already commenced, and the directors believe that in a very few weeks they will be able to show a subscription list which will not do discredit to the exertions that have been used. While on the subject of wires and wayleaves, it is proper to refer to the difficulties that have been met with in this respect at the hands of the United Telephone Company. It is with considerable reluctance that the directors have referred in their report to the opposition this company has met with by the United Company. There is ample room in this great metropolis, much more in the United Kingdom, for half a dozen telephone companies to carry on a lucrative business, but the United Company, for reasons best known to themselves, have from the very outset not only put every

difficulty in the way of the promoters of this company, but of the company itself—after its capital was subscribed—in doing business. The object of this opposition is now plain. The United Company have determined if possible, and at any expense, to strive for a monopoly of the telephone business in the metropolis. As soon as the United Company found this company establishing its routes and lines for exchanges, it did all in its power to oppose and obstruct the company in its operations, and devices had been had recourse to by the United Company which are scarcely honourable. With regard to wayleaves, in every possible instance the United Company have tried to block out this company's lines and prevent available routes being secured. This opposition, carried as far as the criminal prosecution of this company's assistant general manager and some of its servants, has not succeeded, and the directors have good reason to be satisfied with what has been done by their construction manager in these respects, and to regret only that the opposition which has been met with has been productive of more delay than was anticipated. More recently the United Company had made attempts to prevent this company from using any telephone instruments whatever. These attempts have failed because the directors believe they have sufficient instruments protected by the fiat of Her Majesty's Attorney-General, or from other causes which it will not be prudent to enlarge on here to answer all purposes for some considerable period, and the directors trust the shareholders will now day by day hear of increased activity with regard to the company's business, and a daily increase in the number of subscribers to the company's exchanges. That the company yet have difficulties to contend with, the directors do not desire to conceal. The recent litigation commenced by the United Company against this company—three Chancery actions having lately been launched by the United Company—must be contested, and the rival company will doubtless, if they carry out their opposition in the spirit in which it has hitherto been conducted, use every opportunity of harassing this company by litigation, or otherwise, regardless of consequences, and in the hope that the proceedings will embarass the action of this company, and thereby secure the monopoly which the United Company are endeavouring to obtain. The directors would remind the shareholders that telephone business is of a somewhat novel and very peculiar character. It takes time to develop, but with patience and means at command, the directors believe that success must eventually attend the efforts of this company, and having regard to the small amount of capital upon which this company has to pay a dividend, compared with the enormous capital of rival companies, success in this case, in the view of the directors, means a most remunerative income and large dividends, but to arrive at this successful result, the directors call upon the shareholders to rally round them, and not only support them in the difficult enterprise in which they are involved, but to use their influence in every direction to increase the number of subscribers of the company, bearing in mind that every additional subscriber often carries with him a number of others, and that when the lines are once established and the exchanges are opened, additional subscribers means additional profit at a comparatively small additional expense. I beg to move the adoption of the report and accounts. If any shareholder has any questions to ask I shall be glad to answer them.

Mr. R. Ewing seconded the motion.

Mr. Jackson asked why it was that their meeting was held so late as the 4th July considering that the accounts were only made up to the 31st December last, or why were not the accounts made up to a later date?

The Chairman replied that the articles provided for the accounts being made up to the 31st December. The directors would very willingly have called the meeting many weeks ago, but they could not see their way to do so. The shareholders might rest assured that everything was now going on very well.

The report and accounts were then adopted.

The Chairman explained that a casual vacancy in the board having occurred through the illness and resignation of Mr. Harvey, the board had filled the vacancy by electing Mr. Jocelyn T. F. Otway, who was a large shareholder, as a director.

Mr. Hayes proposed, and Mr. Burton seconded the confirmation of the election of Mr. Otway, which was agreed to.

On the motion of Mr. Ash, seconded by Mr. Staple, Messrs. Chatteris, Nichols, & Chatteris, the retiring auditors, were re-elected.

The meeting then separated.

The Directors of the London and Globe Telephone and Maintenance Company have published a circular calling attention to a notice issued on the 18th ult., by the United Telephone Company, and announcing that the London and Globe Telephone and Maintenance Company are the proprietors of instruments protected under the fiat of the Attorney-General. The notice referred to is signed by the secretary of the company, and is as follows:—"The directors of the United Telephone Company (Limited), regret that the notice against infringers, on page 7 of the Classified List of Subscribers to the Exchange System, recently sent out, was inadvertently issued without the reference to the Attorney-General's fiat of the 16th of August, 1882, which should have been made in accordance with an undertaking given by the company to the court in February last. The statement contained in the notice that 'No form of transmitter, in which carbon or any other equivalent substance is employed, can be manufactured, sold, supplied, or used in this country, except under licence from the United Telephone Company (Limited),' should have been qualified by stating that 'certain instruments are protected from proceedings under the terms of the Attorney-General's fiat of the 16th August, 1882.' The directors have endeavoured to recall all copies of the classified list containing the incomplete notice, and if by any accident the copy you received still remains in your possession, I shall be obliged if you will be good enough to return it to the company's office. Another copy shall be sent to you in the course of a few days."

The Brush Electric Light and Power Company of Scotland, Limited.

An extraordinary general meeting of this company was held at St. Michael's Hall, George Yard, Lombard Street, E.C., on Thursday, the Earl of Crawford and Balcarres presiding.

The Secretary (Mr. F. M. Brockelbank) having read the notice convening the meeting.

The Chairman said: When this company was first brought into existence, everything that had to do with electricity was in the most flourishing condition. We had no difficulties before us with the exception of those which were purely technical. We had gentlemen working in science who had devoted their lives to it, and whose interest and delight it was to overcome all the difficulties laid before them. We were like a ship on smooth water coming towards a harbour, where there was a reef which rather obstructed the passage, but by the aid of these men we were enabled to blow up that reef and gain a clear entrance into the harbour. Since that time, after our having overcome these technical difficulties, we have found that the art of man, not content with overcoming difficulties, has raised obstacles before us in our undertaking. I refer to the obstacles in legislation on the subject of the electric light. The action of the Government in taking up the Electric Lighting Bill has, in my opinion, placed hampering conditions upon what was going to be a flourishing trade in this country, which have never been equalled or exceeded in the annals of this country's commercial prosperity (hear, hear). When last I had the honour of standing before you we had applied for provisional orders for starting work in the four principal towns of Scotland, namely, Glasgow, Edinburgh, Aberdeen, and Dundee. By the peculiar requirements of the Board of Trade, they require a coalition between the municipal authorities and the companies before they will issue what is called a provisional order. We did all we could, and our worthy managing director worked very hard, but we were not able to meet the requirements of either the Edinburgh, the Glasgow, or the Aberdeen municipal authorities satisfactorily to ourselves, and you will coincide with us that it was our duty not to agree to terms upon which it was impossible for us to work with any degree of profit. We have, however, been able to carry with us the municipal authorities of the flourishing town of Dundee. They are, I will not say more enlightened, but are willing to be more enlightened in this respect than the other municipal authorities that we have had to deal with. The consequence is that after excessive trouble, excessive worry, and constant communication, we have been able to obtain from the Board of Trade the Dundee Lighting Act. We hope to proceed with this provisional order immediately. We consider that we ought to be able to make a good thing of it. The Dundee municipal authorities have shown a great desire that the experiment should be tried in their town. We think it right in the interests of the company to try that experiment, and we also think it is due to the municipal authorities of Dundee to meet them in the same manner as they have met us. While we are doing this public lighting we shall lose no opportunity of trying to push the matter in private enterprise in the districts around; and neither in Dundee nor in any other part do we intend or desire to work at other than at a profit (hear, hear). Since we last met, your board has received many letters from different shareholders urging different and various courses of action on their notice. We have received special letters urging upon us to reduce the capital of the company by the uncalled amount of the shares now lying out. Your directors have taken this matter into their most earnest consideration, and having ample funds for carrying out the work in respect to the Dundee order, we have come to the conclusion that it is to the advantage of the company that we should reduce the capital by £55,000, being £2 10s. per share uncalled on the 22,000 shares which have been issued. By doing this I think you will improve the property which you have at the present moment; it will take away from you the sting or fear of having to pay up what appears at the present moment, although I hope it will not continue to be so, an unprofitable concern. We have now nearly arrived at the end of the parliamentary year; we can no longer obtain provisional orders until this time next year, and in order to obtain those orders which we hope to be able to obtain next year, after having educated the municipal authorities of Scotland into a more amenable frame of mind, we have given the required notice to no less than fifteen towns in Scotland that we intend to ask for provisional orders for the lighting of these towns next year (hear, hear). In addition to the feeling that it would be right for us to relieve the shareholders of the £2 10s. unpaid we have the knowledge, as I have said, that we have ample funds lying in our hands to meet all that is required for the Dundee order. In the event of our obtaining a certain number of the fifteen provisional orders which we have given notice for for next year, it will be necessary for us to have more capital, and in that case we shall simply issue the shares which are lying in the share-book as unissued, but we hope at the same time that we shall be able to show that the money which is to be used in Dundee will be used in such a way as to secure a request for those new shares (hear, hear). It was, as I said before, the desire of your directors to meet the wishes of the shareholders in the manner suggested. The consequence was that we drew up most carefully the resolutions which will now be placed before you. I move the first resolution as follows:—"That the capital of the company be reduced from £300,000, divided into 60,000 shares of £5 each (of which a first issue of £8,000 shares of £5 each, fully paid, and 22,000 shares of £5 each, with £2 10s. called up thereon, has been made), to £245,000, divided into 38,000 of £5 each, and 22,000 shares of £2 10s. each, and that such reduction be effected by reducing the liability upon each of the 22,000 shares by the sum of £2 10s., being the amount uncalled thereon."

Mr. Ashley Ponsonby seconded. He fully concurred with the resolution for the reason that when there was no liability on the shares the outside public were very apt to more willingly buy the shares than if they had liabilities behind them. He wondered when

the Board of Trade were to come to their senses; he never saw such obstruction as theirs. The trouble they had given their company was something tremendous. The trammels they had put upon that company, in the opinion of the directors, made it impossible for them to carry out anything but the Dundee installation this year. But that was no reason why they should not carry out several installations next year, and he had no doubt but that next year they should have other municipal authorities coming to them. He believed the time was coming when they should be able to induce the municipal authorities to come to them instead of their going to the municipal authorities. Every year they got fresh inventions, and better inventions than the preceding ones; he did not mean to cast any slur on those they had, but after all, electric lighting was in its infancy, and he thought the best thing they could do would be to reduce their shares in the meantime.

In reply to Mr. Walker,

Mr. Dickson said the company had money to do all the work they had at present in hand, and they would of course do their utmost to make a profit. The shareholders would be duly informed whether or not the Dundee work paid the company.

A Shareholder: Are you able to take advantage of those improvements which will most certainly come to pass in various ways during the next twelve months?

Mr. Dickson: Our articles of association provide for our taking advantage of anything except as far as regards the Brush Company; and I may say that the Brush Company always meets us in a very liberal spirit indeed.

Mr. Molleson objected to the resolution, as did also Mr. Hope, who said he was advised on the very best authority that such a step was illegal. If it was taken the funds of the company would be spent at law.

Mr. Harrington supported the resolution.

Mr. Wilkinson, the solicitor to the company, having been appealed to, said he knew no grounds for the statement that such a step was illegal, and he believed the reason why he had not heard of any such grounds was that there were none (laughter).

The resolution was then put to the meeting and carried by 33 to 7.

Mr. Molleson: I object to your taking my property and dealing with it in any such way (laughter).

The Chairman here read a letter, dated the 4th inst., which had been sent to the secretary by Messrs. Abrahams & Co., solicitors, on behalf of Mr. Hope and other shareholders, giving notice that the resolutions which were to be submitted to that meeting were illegal, and that in the event of the same being passed Mr. Hope and other shareholders would bring an action of restraint in the High Court of Justice. Several names of gentlemen were appended to that letter as the shareholders who were to take action—Mr. Hope's name was not among them—but several of these names, the Chairman said, were not on the registered list of shareholders (laughter).

The following resolutions were also put to the meeting and adopted:—"That the 8,000 shares of £5 each be sub-divided into 16,000 shares of £2 10s. each," and "That the 30,000 shares of £5 each at present unissued be sub-divided into 60,000 shares of £2 10s. each."

The meeting then separated.

The Eastern Telegraph Company (Limited).—

The report and accounts of the directors, for the half year ended March 31st, says the company's revenue amounted to £328,404 14s. 11d., from which are deducted £87,827 1s. 10d. for the ordinary expenses, and £50,901 6s. 3d. for expenditure relating to repairs of cables, &c., during the half-year. After providing £1,943 14s. 3d. for income tax, there remains a balance of £187,732 12s. 7d., to which is added £56,836 7s. 6d. brought from the preceding half-year, making a total of £244,569 0s. 1d. From this amount there is deducted £22,479 16s. 8d. for interest on debentures, £20,297 4s. 5d. for dividend to 31st March, 1883, on the preference shares, and £85,000 placed to the general reserve fund, leaving a balance of £116,791 19s. The directors have during the half-year paid an interim dividend of 2s. 6d. per share on the ordinary shares for the quarter ending December, 1882. They now recommend the declaration of a final dividend for the year ended 31st March, 1883, of 2s. 6d. per share, and a bonus of 1s. per share, both payable on the 14th instant, making, with the three previous payments on account, a total distribution of 12s. 0d. per share, or 6 per cent. for the year on the ordinary shares. The balance of £2,791 19s. 0d. shown at the foot of the revenue account is proposed to be carried forward to the next half-year. The general reserve fund, after adding the interest received during the half-year, now amounts to £537,889 10s. 5d.; this, with the special reserves stated on the balance-sheet, makes the total amount of reserves £569,828 0s. 6d. The revenue includes £14,479 12s. 1d. net receipts for the half-year upon the company's shares in the Eastern and South African Telegraph Company. The reserve funds of that company now amount to £155,520 4s. 5d., and in addition the sum of £54,220 16s. 8d. is held by the trustees of the sinking fund for redemption of debentures. The revenue account also includes £2,600 dividend for the half-year on the shares of the Black Sea Telegraph Company, belonging to this company, by which the line is worked and maintained under agreement. The various sections of the company's cables are in good working order, and the company's repairing ships are in efficient condition. The sum of £10,000 has been taken from the ships' maintenance fund in part payment for the s.s. *Volta*. In accordance with the agreement entered into with the Suez Canal Company, the land line connecting the company's cables at Port Said and Suez has been completed and is now in full work. In pursuance of the special resolutions passed last year, the directors have decided to issue £500,000 four per cent. mortgage debenture stock for redemption of debentures falling due in October next, and other capital purposes for which the stock was authorised. As the company's debenture stock constitutes a first charge upon the entire undertaking and revenue, the directors confidently recommend it as an investment.

The Anglo-American Telegraph Company.—

After placing the quarterly sum of £37,500 to the reserve fund, the profits admit of a dividend of 15s. on the ordinary and 30s. on the preference shares for the quarter ending 30th June. The dividends will be paid to shareholders registered on the 30th June, and will be payable on the 1st August, free of income-tax.

The Phosphor-Bronze Company (Limited).—

This company has paid an interim dividend for the past half-year at the rate of 10 per cent. per annum.

LATEST QUOTATIONS.

Authorised Issue.	Shares.	Name.	Paid	Closing Quotations. July 4.	Business Done.
		ELECTRIC LIGHT.			
40,000	10	Anglo-American Brush Co.	7	3½ - 4	3½
		Do. Do.	10	6½ - 7	6⅞
30,000	5	Australasian Electric Light, Power & Storage Co.	3	¼ - ⅜	
24,900	10	British Insulite Co., Limited, "A" Shares	5	1½ - 2½	
30,000	5	Brush Electric Light & Power Co. (Scotland)	2½	⅜ - ½	
25,000	5	Great Western Electric Light & Power Co.	2½	⅜ - ½	
24,980	5	Hammond Electric Light & Power Supply Co.	2½	3½ - 3¾	3⅝ 3⅝ 3⅝
40,000	5	Indian & Oriental Electrical Storage Works Co.	2	..	
172,500	1	Maxim-Weston Electric Light and Power Co.	1	½ - ⅝	
..	..	Metropolitan Brush Electric Light & Power Co.	3	..	
40,000	5	Pilsen-Josel & General Electric Light Co.	2	..	
..	..	South African Brush Electric Light & Power Co.	2½	..	
100,000	5	Swan United Electric Light Co., Limited	2½	2⅝ - 2¾	2⅞ 2⅝ 2¾
		TELEGRAPHS.			
2,116,400*l.*	Stk.	Anglo-American, Limited	100	49 - 50	
2,441,800*l.*	Stk.	Do. Preferred, Def'd. receiving no div. until 6 p. c. has been paid to Pref.	100	81 - 82	81½
2,441,800*l.*	Stk.	Do. Deferred, Def'd. receiving no div. until 6 p. c. has been paid to Pref.	100	18 - 19	
130,000	10	Brazilian Submarine, Limited	10	11½ - 11⅝	xd.
16,000	10	Cuba, Limited	10	10½ - 11	
6,000	10	Do. 10 per cent. Preference	10	17½ - 18½	
13,000	10	Direct Spanish, Limited	9	5⅜ - 5⅝	
6,000	10	Do. 10 per cent. Preference	10	15⅜ - 16	
65,000	20	Direct United States Cable, Limited, 1877	20	12½ - 12⅝	
100,000*l.*	100	Do. 6 per cent. Debenture, repayable 1884	100	99 -102	
380,000	10	Eastern, Limited	10	10⅝ - 11	10⅝ 11 10⅝
70,000	10	Do. 6 per cent. Preference	10	13 - 13½	
232,000*l.*	100	Do. 6 do. Debentures, repayable Oct. 1883	100	100 -102	
200,000*l.*	100	Do. 5 do. do. Aug. 1887	100	101 -104	
200,000*l.*	100	Do. 5 do do. Aug. 1899	100	104 -107	
199,750	10	Eastern Extension, Australasia & China, Limited	10	11⅜ - 11⅝	11⅝
50,250		Do. New Shares, 1883	10	11⅜ - 11⅝	
320,000	100	Do. 6 p. c. Debentures, repayable Feb. 1891	100	109 -112	
500,000	100	Do. 5 p. c. (Australian Gov. Subsidy) Deb. 1900	100	102 -106	103⅜ xd
140,000	100	Do. do. registered, repayable 1900	100	102 -106	xd.
100,000*l.*	100	Do. 5 per cent. Debenture, 1890	100	102 -105	
254,300*l.*	100	Eastern and South African Limited 5 per cent. Mort. Deb. Registered redeemable 1 Jan. 1900	100	101 -104	xd.
345 700*l.*	100	Do. do. do. To Bearer	100	101 -104	xd.
22,050	10	German Union Telegraph and Trust Limited	10	10 - 10¼	xd.
163,390	10	Globe Telegraph and Trust, Limited	10	7⅛ - 7⅜	7⅛
163,209	10	Do. 6 per cent. Preference	10	12⅝ - 13⅛	13
125,000	10	Great Northern	10	12⅜ - 12⅝	12⅜
100,000*l.*	100	Do. 5 per cent. Debentures	100	100 -102	xd.
300 000	100	Do. 5 per cent. Debentures	100	101 -104	xd.
31,200	10	India-Rubber, Gutta-Percha and Telegraph Works	10	30½ - 31½	
100,000	100	Do. 6 per cent Debentures, 1886	100	103 -106	
17,000	25	Indo-European, Limited	25	31½ - 32½	xd.
38,148	10	London Platino-Brazilian, Limited	10	3½ - 4	
12,050	10	Mediterranean Extension, Limited	10	1¾ - 2	
8,200	10	Do. 8 per cent. Preference	10	5½ - 6½	
9,000	8	Reuter's, Limited	8	9½ - 10	
280,000	Stk.	Submarine	100	247 -252	
58,225	1	Do. Scrip	1	2½ - 2¾	
4,200	Cert.	Submarine Cables Trust	100	103 -105	
37,350	12	Telegraph Construction and Maintenance	12	33½ - 34½	
150,000	100	Do. 6 per cent. Bonds, 1884	100	98 -101	xd.
186,750	5	Do. 2nd Bonus Trust Cert.	2½	1⅛ - 1¼	
30,000	10	West Coast of America, Limited	10	4½ - 5	
150,000	100	Do. 8 per cent. Debentures	100	104 -108	
69,910	20	Western and Brazilian, Limited	15	5⅝ - 6¼	xd.
		Do. Preferred	7½	5⅝ - 6¼	
		Do. Deferred	7½	1¼ - 1½	
200,000*l.*	100	Do. 6 per cent. Debentures "A" 1910	100	105 -109	
2,500	100	Do. 6 p.c. Mort. Deb. series B of '80, red. Feb., 1910	100	98 -102	
1,500	$1,000	Western Union of U. S. 7 p.c. 1 Mort. (Building) Bds.	$1,000	122 -124	
1,030,000*l.*	100	Do. 6 per cent. Sterling Bonds	100	103 -106	
88,321	10	West India and Panama, Limited	10	1 - 1¼	
34,563	10	Do. 6 per cent. 1st Preference	10	6½ - 7	
4,669	10	Do. 6 do. 2nd do.	10	5 - 5½	
		TELEPHONES.			
154,165	1	Con. Telephone & Maintenance, Ld. Nos. to 154,165	1	⅜ - ½	
200,000	1	Oriental Telephone Co., Nos. 80,001 to 300,000	¼	⅜ - ½	½
100,000	5	United Telephone Co.	5	9½ - 10	

TRAFFIC RECEIPTS.

The Brazilian Submarine Telegraph Company, Limited. The receipts for the week ended June 22nd amounted to £2,820.

The Cuba Submarine Telegraph Company, Limited. The number of messages passing over the lines of this company during the month of June was 3,120, estimated to produce £2,700, against 3,023 messages, producing £2,951, in the corresponding month of last year. The March receipts, estimated at £4,500, realised £4,609.

The Direct Spanish Telegraph Company, Limited. The estimated receipts for the month of June were £1,552, against £1,963 in the corresponding period of last year.

The West India and Panama Telegraph Company, Limited. The estimated receipts for the half month ended June 30th were £2,478, as compared with £2,586 in the corresponding period of 1882. The February receipts, estimated at £6,742, realised £6,869.

NEW PATENTS—1883.

3074. "Dynamo-electric machines." M. DEPREZ. Dated June 21.

3080. "Telephones." A. W. ROSE. Dated June 21.

3100. "Incandescent electric lamps." R. HARRISON. Dated June 22.

3102. "Telephone." S. J. COXETER and H. NEHMER. Dated June 22.

3109. "Construction of pavements and roadways where it is required to accommodate telegraph and other wires, gas pipes, and the like." E. G. BANNER. Dated June 22.

3114. "Mariners' compass, chiefly designed for use in iron vessels." W. R. LAKE. (Communicated by E. Bisson.) Dated June 22.

3115. "Dynamo-electric machines." G. FORBES. Dated June 22.

3116. "Arrangement of circuit and apparatus to be used in connection with telephonic communication. S. PITT. (Communicated by C. E. Scribner.) Dated June 22.

3123. "Electrical apparatus and circuit connections to storage or secondary batteries for charging and discharging such secondary batteries and utilising the electric current." W. HOCHHAUSEN. Dated June 23.

3126. "Application of governors or apparatus for making and breaking contact between electro-motors and accumulators combined therewith for regulation of motors and inserting resistances." Sir D. SALOMONS. Dated June 23.

3127. "Preparation and manufacture of a compound from vegetable materials suitable for electro non-conductors and insulators, applicable also to other useful purposes." E. C. T. BLAKE. Dated June 23.

3131. "An improvement in a new contrivance, by wiring and telephoning, to communicate from to delivery office without calling on the intervening stations, to the receiving office." O. SCHÄFFLER. Dated June 23. (*Complete.*)

3167. Improvements in incandescent electric lamps and in the mode and means of regulating the illuminating power thereof." H. J. HADDAN. (Communicated by R. S. H. Thompson.) Dated June 26.

3182. "Galvanic batteries." J. R. and J. W. ROGERS. Dated June 27.

3185. "Telephonic transmitters." C. F. POLLAK. Dated June 27.

3211. "Manufacture or treatment of porous pots and porous plates for galvanic batteries." T. COAD. Dated June 28.

3218. "Apparatus for mounting or supporting electric lamps." W. R. LAKE. (Communicated by J. Languereau.) Dated June 28.

3219. "Distribution of electric currents." H. E. NEWTON. (Communicated by A. J. Gravier.) Dated June 28.

3223. "Dynamo-electric, magneto-electric, and similar machines." L. F. LAMKIN. Dated June 29.

3233. "Electric arc lamps." C. WÜEST. Dated June 29.

3244. "Automatic electric signalling apparatus for railways." H. J. HADDAN. (Communicated by H. C. Reher.) Dated June 30.

3271. "Telephonic apparatus." A. J. BOULT. (Communicated by C. S. Steele.) Dated July 2.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1882.

5055. "Generating and storing electricity." F. H. VARLEY. Dated October 24. 8d. Relates to dynamo-electric machines capable of generating currents of electricity suitable for producing electric light, motive-power, or for other purposes for which such currents are available, used in combination with improved means whereby the current desired may be stored up in accumulators or secondary batteries, arranged either in multiple or continuous series. Fig. 1 shows general arrangement of the field and armature coils of a four-pole machine, in which A represents a carrying frame supporting the tangential armature coils, *b b b*, &c., with their radial wrappings, and the subsidiary magnetising circuit, *c c c*, &c.—D, the framework uniting the field-magnets, and forming the general support for the bearings through which the rotary armature is driven. Fig. 2 represents the armature removed from the field-magnets showing the longitudinal and radial wrappings of the coil, *b b b*, and the connections to the commutators, B, taking the connections from the coils, *b b b*, &c., which are connected to the commutator straps or segments, b^1 b^1 b^1, whilst the subsidiary or field-charging circuits are connected to the commutator, C, and joined respectively to the commutator segments or straps, &c. The armature is driven in the direction shown by the arrow, and it will be seen that there are always two radial poles, and for a considerable part of the time three radial poles presented to each field-magnet, thus in the four-field machine, the armature is divided into four magnetising systems developing currents in the coils, *b b b* and *c c c*, &c.; these are drawn off from the rotary commutator by connecting combs in the usual way.

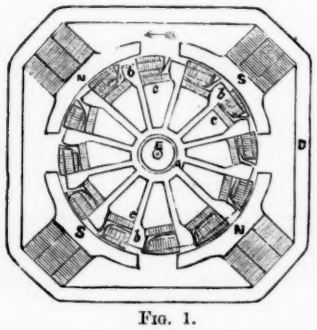


FIG. 1.

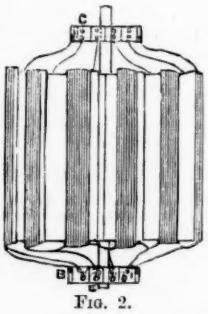


FIG. 2.

5170. "Electric batteries" F. WIETH. (A communication from G. LEUCHS, of Germany.) Dated October 30. 2d. This invention relates chiefly to improvements in existing carbon manganese cells. The inventor substitutes for the small rod of zinc usually employed in these cells, zinc having a large surface, and for the solution of sal ammoniac a solution of caustic potash or soda. (*Provisional only.*)

5174. "Arc electric lamps." F. L. WILLARD. Dated October 31. 2d. Relates to improvements in arc electric lamps. (*Provisional only.*)

5181. "Apparatus for accommodating electrical conductors in streets." H. F. JOEL. Dated October 31. 2d. Relates to a construction and arrangement of pavement-curb and appliances in connection therewith for the accommodation of electrical conductors extending along the streets of towns so as to be put in communication with lamps or with houses or other structures. (*Void by reason of the Patentee having neglected to file a Specification in pursuance of the condition of the Letters Patent.*)

5182. "Telegraph printing and time regulating apparatus." J. IMRAY. (A communication from abroad by A. A. Knudson of America.) Dated October 31. 6d. Relates to the apparatus described in the No. of the ELECTRICAL REVIEW for February 24th, 1883.

5183. "Secondary voltaic batteries, &c." R. H. WOODLEY and H. F. JOEL. Dated October 31. 6d. Relate to the construction and arrangement of the parts of secondary voltaic batteries and to apparatus for regulating their charge and discharge. The inventors make a secondary battery, consisting of a number of plates or slabs separated by partitions in the following manner: They pile together one above the other a number of thin plates of lead and press them firmly together. They then advance the pile step by step to a reciprocating or rotating knife or set of knives which shears thin slices from the edge of the pile. Each of these slices separates itself into as many separate filaments as there are plates in the pile, and they thus produce a kind of lead wool, presenting in moderate weight a very large amount of surface. This wool may be electrolytically coated with oxide, or subjected to nitric acid. Or the lead plates before being piled together may be coated either by painting or by electrolytic action with lead oxide or other material, such as vermilion, that can be employed along with lead in a secondary battery. When the plates have thus been coated, the lead wool produced by the shearing has the oxide or other material mechanically mixed with it.

5200. "Controlling valves or cocks by electricity or heat." J. FORMBY. Dated October 31. 6d. The object of the invention is to regulate the heat or temperature of rooms, conservatories, or chambers by means of a peculiar construction of gas valve actuated to regulate the flow or passage of gas to burners through the medium of an electric contact-making thermometer, or by the rise and fall of a mercury column controlled by heat.

5205. "Utilisation of various gums as substitutes for gutta-percha and india-rubber for insulating, &c." J. E. T. WOODS. Dated November 1. 2d. Consists in the utilisation and purification of various natural gums hitherto not used in commerce so as to render them suitable as substitutes for gutta-percha and india-rubber for electrical, insulating, and other purposes to which the last-named substances are generally applied. The juices of the barks of the gutta shea tree or tallow tree, and several descriptions of climbing tropical plants yield gums more or less resembling gutta-percha and india-rubber, are used for the purpose. (*Provisional protection not allowed.*)

5241. "Electric time ball apparatus." W. R. LAKE. (A communication from abroad by the Standard Time Company (Incorporated) of America. Dated November 2. 6d. This invention relates to improvements in that class of time signals in which a ball is arranged upon a vertical rod, and is held suspended by an electrical apparatus adapted to be released at a certain predetermined time by electrical connection with some distant point so that the fall of the ball will indicate that particular time, which signals are commonly called "time balls." The object of this invention is to give the ball the greatest amount of freedom when it begins its descent, and gradually apply a counterbalancing weight. The said invention consists principally in a counterbalancing weight supported independently of the ball, when the latter is raised, and an elastic device between the said weight and ball, whereby the weight is gradually applied to the descending ball.

5254. "Driving tram-cars by electricity." A. RECKENZAUN. Dated November 3. 6d. Relates to the driving of vehicles by electric energy and comprises means for varying the speed of such vehicles without materially changing the speed of the electro-motor. The said invention is based on the fact that electro-motors develop the greatest efficiency when working at one particular speed, and if the speed thereof is decreased by reason of a temporary increase in the work to be performed (for instance, when the vehicle is going up hill, or when it is being started) the result is a great waste of energy in heating the wires of the armature, therefore it is desirable that the

speed of the electro-motor should, as much as possible, be independent of the variations in the speed of the vehicle, and the invention is designed to accomplish this result. In applying the invention to a tram-car, the inventor places the electro-motor in any convenient position under the car and arranges the same in combination with adjustable pulleys for communicating motion to the car-wheels. These pulleys are so constructed and arranged that the effective or acting diameter of the said pulleys and consequently the speed of the driven shaft can be varied at will, whilst the driving shaft, that is to say the shaft of the electro-motor, maintains a constant velocity. The apparatus may be seen in our description of the electrical tram-car published in the ELECTRICAL REVIEW for March 24th of the present year.

5265. "Generating and utilising electricity for medical purposes." T. WELTON. Dated November 4. 2d. This invention has for its objects novel methods of utilising a current of electricity for medical or curative purposes by passing such current, before its application to a patient, through a medicinal substance such as a drug, salt, or tincture, or a combination of two or more such substances appropriate to the disease which is to be treated. (*Provisional only.*)

5276. "Utilising motive force of waves, chiefly for production and storage of electrical energy." W. R. LAKE. (Communicated from abroad by A. de Souza, of Paris.) Dated November 4. 8d. The object of this invention is to apply the movement of translation of the waves to the production of force, notwithstanding the irregularity of such motion, for storing variable quantities of electricity in accumulators of any suitable description, permitting of furnishing currents of electricity of a constant intensity, either upon the spot or at a distance. The said invention is based upon the following principles, that is to say, first the reception by means of suitable apparatus floating or not, of the force produced by the alternative movement of translation of the waves in advancing and retreating; second, the action of this apparatus (floating or otherwise) in a similar manner to that of pistons, upon a system of machines connected to the said apparatus in any manner adaptable to the irregularities arising from the movement of the waves and of the tides; and third, the application of this motive force, thus regulated, for actuating powerful electric machines, the currents from which can be employed directly upon the spot or at a distance, or can be made to charge accumulators to be employed for any desired purpose.

5278. "Manufacture of telegraph cables." G. E. VAUGHAN. (A communication from abroad by S. Trott and F. A. Hamilton, both of Canada.) Dated November 4. 4d. Relates to the manufacture of an improved form of submarine telegraph cable and has for its object the prevention of any twisting or ringing asunder of the cable whilst being submerged or during the process of heaving in for the purpose, of repair or recovery. To prevent this wringing and twisting asunder the cable is manufactured in compensating layers, that is to say, the strength-giving material is divided into equal or nearly equal parts, one part of which is laid around the insulated conductor (which may have been previously prepared with a padding of jute or other fibrous material) in one direction and the other part is laid around in the opposite direction, thereby compensating for the twisting tendency of the under layer or first serving of strength-giving material. Around this prepared core is laid helically about half of the strength-giving material, say, from left to right. The other portion of the strength-giving material is then taken and laid on helically over the previous layer and in the opposite direction.

5304. "Machinery for producing dynamo and magneto-electricity, &c." H. MAYHEW. Dated November 7. 10d. Relates to (1) a magneto-electric machine or "exciter;" (2) an electro-magnetic machine or "generator;" (3) "a galvanometric multiplier" machine or magneto deflector.

5315. "Insulating compounds, and processes for insulation of electric conducting-wires and cables." J. WEITER. (A communication from abroad by R. S. Waring and J. B. Hyde, of America.) Dated November 7. 4d. This invention consists in enveloping the wires in an arming or shield of fibrous material, preferably cotton threads, that are wound or braided around the wire, effectually employing the same, and afterwards subjecting this wound wire to artificial heat, effectually to dispel all moisture therefrom, or in exposing the wound wire to heat in an insulating medium to saturate and coat the arming, thereby not only expelling all moisture, but effectually coating the same to insure its repulsion of all moisture from again entering them. And this invention also consists in subjecting a complete cable to the action of dry heat in a closed chamber, to insure the expulsion of all moisture therefrom. And this invention further consists in a new insulating medium.

5353. "Manufacture of carbons for electric lighting." H. C. B. SHALDERS. Dated November 9. 2d. This invention has for its object improvements in the manufacture of carbons for electric lighting. For this purpose the inventor takes peat, either moss peat, or bog peat, or bog oak, but preferably moss peat of the genus Sphagnum, now commonly imported from Rhenish Prussia. This latter material is practically free from earthy impurities, and ordinarily needs no preliminary cleansing; but if it contains impurities, or if using other forms of peat contaminated with impurities, the inventor first cleanses the peat by washing in water, or with acid, or alkaline solutions as may be necessary. Having done this, the material is dried, preferably by free exposure to the atmosphere, but artificial heat may also be employed. When the material has been sufficiently dried it is calcined in closed vessels at a high temperature. To the resulting product is added sufficient syrup of sugar, starch, rice, and gum, or such like, to make it into a paste. This mixture is then compressed by any known method into moulds of the form required with high pressure, and then again the now moulded carbons are submitted to a high temperature in closed vessels.

5346. "Incandescent electric lamps." J. JAMESON. Dated November 9. 4d. Consists in a combination and arrangement whereby the carbon filament of an incandescent electric lamp under ignition may be thickened or reduced in section at will, or kept approximately uniform by being supplied continuously with a restricted supply of more or less attenuated hydro-carbon gas or vapour so as to compensate for the dissipation due to the incandescence, and whereby the deposit on the glass envelope occasioned by the decomposition of the hydrocarbon gas or vapour within the same during incandescence may be cleaned off.

5359. "Insulating electric wires." W. J. TEMPLE and T. F. HOBBS. Dated November 10. 2d. Relates to the means of insulating electric wires for the conveyance of electric currents, so as to give a good and convenient insulation and protect buildings or other places against the risk of being accidentally fired in the transmission of the current. The inventors take strips or mouldings of slate and form therein a groove or grooves for receiving the wire, or cable, or the like. The strips or mouldings are put together or constructed in such a manner as will permit of their being taken apart for examination, renewing, or addition without damaging the building or place where they are used. (*Provisional only.*)

5373. "Electric lamps, &c." J. M. BOULLON, I. PROBERT, and A. W. SOWARD. Dated November 16. 6d. The invention relates to that kind of electric lighting apparatus in which a filament of carbon or other material is rendered incandescent by the passage of an electric current through the same. According to one part of the said invention, the inventors manufacture light-emitting conductors in the following manner, that is to say, they take a suitable gas or vapour and subject it, as hereinafter described, to the action of the electric spark, which may be produced by any suitable generator of high tension electricity. For this purpose they provide a globular or other suitably shaped vessel or casing of glass, in which are inserted metallic conductors or electrodes. They prefer to use platinum for the said electrodes, the ends thereof being arranged at a suitable distance from each other within the globe. These metallic electrodes may be either solid or tubular; if made tubular, they make the interior ends conical and closed at the point, and the conical part is provided with apertures. In some cases carbonaceous gas or vapour, such as marsh gas, or coal gas, is introduced into the glass vessel and is decomposed by the passage of electric sparks through the same. A slight deposit of carbon takes place upon the end of one of the electrodes, which

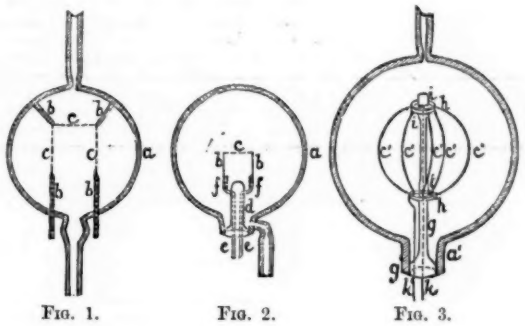


FIG. 1. FIG. 2. FIG. 3.

deposit is gradually built up by means of a rapid succession or continuous flow of sparks, and a bridge of carbon is thus formed, so that the space separating the said metallic electrodes, between which the spark passes, is completely arched over. This bridge forms the filament to be used as the light-emitting conductor. After exhausting and sealing the glass vessel in any of the usual manners the lamp is ready for use. But when the metallic electrodes are made tubular the inventors inject into them a suitable conducting paste after the filament is completed; this paste passes through the tubes and issues from the apertures at their conical ends and surrounds the parts where the ends of the filaments are attached, thereby making a more efficient connection between the electrodes and the filaments. They then close the exterior ends of the metallic tubes with melted glass or other suitable material. Fig. 1 is a diagram illustrative of a lamp provided with four electrodes and three deposited filaments, the latter being represented by dotted lines. Fig. 2 is a diagram illustrating a lamp with two metallic conductors passing through a glass stem and sustaining a single filament. Fig. 3 is a diagram illustrating a lamp having a number of filaments of carbonised cellulose or other suitable material.

5387. "Apparatus for regulating and controlling electrical currents." P. R. ALLEN. Dated November 11. 6d. Has for its object to provide a convenient means for regulating and controlling electrical currents, more especially adapted for regulating and controlling the current to incandescent electric lamps, being as it is capable of operation for regulating the intensity of the light or the extinguishing of the same by operation by means of a tap or handle resembling and operated as that employed for regulating or stopping the flow of gas to gas-lamps. According to the said invention there is arranged in the instrument a series of carbons as a variable resistance for the current, and also a direct metallic circuit, through which the current passes clear of the carbons when the lamp is lighted to its full intensity. The tap or operating handle is provided with a screw which screws upon a rod to compress more or less the carbons, and the said tap has also contact pieces, which when the light is neither full on nor extinguished bear upon contact pieces, upon the body of the instrument, so that the current flows through the carbons. By turning the tap or handle the screwed rod acts

through suitable contact pieces upon the carbons to compress them less or more, so as to regulate the light to a less or greater intensity the contact pieces, on the tap or handle still maintaining their contact with the contact pieces on the body of the instrument, which contact pieces are lengthened for this purpose.

5388. "Manufacture of compounds of india-rubber, of gutta-percha, and of oils for insulating electrical conductors, &c." A. PARKES. Dated November 11. 4d. Has for its object improvements in the manufacture of compounds of india-rubber, of gutta-percha, and of oils for insulating electrical conductors and for other uses. The inventor prepares india-rubber or gutta-percha or oxidised castor or linseed oils in such manner that either of them or combinations of them one with the other will become incombustible—or combinations of these with other substances, such as paraffine, gums, unoxidised castor oil, pigments, steatite, or colouring matters. For the above purpose he prefers to employ phosphate of zinc or phosphate of lead or oxychloride of zinc or lead or magnesia. By combining paraffine or gums and oil such as castor oil with india-rubber or gutta-percha, the inventor is able to incorporate with them a greater proportion of the substances used for rendering them uninflammable than he otherwise could, and so is able to render them altogether uninflammable.

5409. "Apparatus for electric lighting." J. MUIRHEAD and T. M. COLLET. (Communicated from abroad by G. A. Grindle, of India.) Dated November 13. 6d. Has for its object improvements in apparatus for electric lighting, and relates to a shunt or switch capable of shunting a heavy current from one circuit to another without sparking at the points of contact and without any period of total extinction in both circuits. This is effected by a switch consisting of a handle turning on a centre, and carrying a spring arm which moves through a segment of a circle and makes a sliding contact with one or other of two blocks on which the spring slides and rests. These blocks are so arranged as to extend a short distance past each other at the centre position of the spring, so that it makes contact with the one before it leaves the other, and thus the circuit is never wholly interrupted and no sparking can occur. The surfaces of the two blocks have also a slight incline towards their point of intersection, so that the spring rests more lightly upon them in passing the central position than when it is in a state of rest at either extremity of its arc of motion.

5414. "Apparatus for regulating and controlling electrical currents." P. R. ALLEN. Dated November 13. 10d. Relates to improvements in variable resistances used in conjunction with electric lighting apparatus. One part of the invention relates to an improvement in hand regulators for varying the resistance of carbon plates or blocks, and consists in the use of a differential screw to regulate the amount of pressure on the blocks or plates, the use of this differential screw enabling a large amount of motion to be given to the hand-wheel for a small amount of travel to the plate pressing the blocks, thus a fine adjustment can be obtained without any great attention being paid to the hand-wheel, and the motion of the hand-wheel itself having a considerable range enables the degree of compression to be read off direct by means of a graduated scale at the side.

5421. "Thermo-electric generators." H. WOODWARD. Dated November 14. 2d. Relates to improvements in thermo-electric generators, whereby they are rendered more efficient, compact, and durable than those hitherto constructed. In carrying out the invention, the inventor prepares an alloy of antimony and zinc, and casts or forms it into a number of elements of any suitable shape, but the form which he prefers to give to the elements greatly resembles that of a grooved pulley in cross section, and to these elements he attaches by casting, or otherwise, suitably shaped tinned-iron pieces or strips. These elements and the tinned-iron pieces thus combined, are arranged to form a foundation of any required shape, and upon this foundation the inventor continues to build up or place the requisite number of such elements—electrically insulated—in order to form a generator of the required strength and efficiency. The elements are connected in the usual manner. The inner ends or faces of the pairs thus formed, are kept heated, and the outer ends or faces are kept cool. (*Provisional only.*)

5422. "Electrodes for secondary batteries." H. WOODWARD. Dated November 14. 2d. Relates to improvements in the manufacture of electrodes for secondary batteries, and in carrying out this invention the inventor first prepares a dough-like composition or compound, consisting of red lead or other oxide of lead, or other suitable substance, together with water or a saccharine solution, the latter serving as a vehicle to bind the composition together, and render it fit for use. (*Provisional only.*)

5438. "Apparatus for the conduction and distribution of electric currents." R. E. B. CROMPTON. Dated November 15. 4d. Relates to insulated conductors specially suitable among other things for use in electric lighting on a large scale. As an improved means of insulating the copper rods described in the inventor's patent No. 5080, dated November 21, 1881, he uses india-rubber or other suitable elastic gum, as the insulating material, and applies it in the following manner. He coats the copper rod with the india-rubber or other insulating gum by winding it on in the form of a spiral strip, applied longitudinally, the edges being afterwards united by heat or other suitable means, so as to make the coating continuous. After treating the coating with any one or several of the agents known as vulcanising or curing agents such as sulphur, ozokerite, *et cetera*, the inventor places the rod thus covered with insulating material within the sheathing tube, which may be of cast iron, wrought iron, brass or other suitable material; he then subjects the whole to a high temperature maintained for a sufficient period of time to cause the vulcanising or curing agent to enter into intimate combination with the insulating gum and thus complete the process.

TO CORRESPONDENTS.

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CORRESPONDENCE.

On Dynamo Machines.

Allow me to draw attention to an error in Mr. W. Moon's interesting communication, published in your issue of June 9th, entitled "The Direct and Derived Field-Magnet Circuit in the Dynamo."

In the shunt dynamo he assumes that the total energy expended in the circuit is the product:—

(Current in armature) $^2\times$ (resistance of circuit)

It ought to be—

(current of armature) $^2\times$ (resistance of armature);
+ (current in magnet coils) $^2\times$ (resistance of magnet coils);
+ (current in line) $^2\times$ (resistance of line).

This does not invalidate the relationship which he finds between the resistances of the field-magnets series-wound and shunt-wound, viz.:—(series-wound resistance) $\times$ (shunt-wound resistance) = (line resistance)^2 in order to get equal external work with equal magnetic field; but the problem of determining the ratio between the resistances of the armatures in the two cases in order to produce equal efficiency is much more difficult than would appear from the communication referred to.

George Forbes.

34, Great George Street, Westminster.
28th June, 1883.

Magnetic Induction.

Diagrams of the magnetic field are usually drawn with two sets of lines. Faraday only illustrated the magnetic field by the latitudinal lines connecting the two poles of the magnet; but subsequently mathematical writers introduced "equipotential surfaces" in the spherical surfaces around each pole of the magnet; these surfaces cut the lines of force always at right angles, and the intensity of magnetism at any part of the field is indicated by the closeness of these lines of force, or of equipotential surfaces.

Faraday, in speaking of the current induced by a conductor moving through the magnetic field, says the current is proportional to the number of lines of force cut; but it would appear that the introduction into diagrams of the magnetic field of these equipotential surfaces has somewhat altered the meaning of Faraday's words; for it may be proved experimentally that a conductor can be moved across the lines of force without producing any current. This always happens when a conductor is moved in any direction along an equipotential surface, for although the conductor cuts the lines of force at right angles to the surface no current is generated; but, on the other hand, whenever a conductor moves across the equipotential surfaces a current is always generated proportional to the rate at which those surfaces are cut, and the maximum current is generated when the conductor moves at right angles to the equipotential surfaces, that is, along the lines of force; the conductor would also evidently generate the greatest current when it moved along the shortest line of force.

A current, therefore, is only generated when a conductor moves from a lesser to a greater magnetic potential, or *vice versâ*.

The nature of the terrestrial induction machine confirms these remarks; for when the axis about which the coil rotates is in the line of the dip no current is generated; but as the axis of rotation is moved in any direction from the line of the dip a current is generated proportional to the sine of the angle between the axis and the direction of the dip; but the number of equipotential surfaces cut by the conductor in a semi-revolution would also vary as the sine of the angle between the axis of rotation and the direction of the dip; and the sum of the number of equipotential surfaces cut by the different portions of the conductor would be greatest when the axis of rotation of the terrestrial induction machine lay in any direction upon an equipotential surface. From these facts it follows that a conductor does not generate a current when it is moving east and west with respect to the earth, but only when it moves north and south; and it also follows that the current generated would vary as difference of the magnetic potential through which the conductor passes in unit time.

W. Moon.

June 30th, 1883.